United States
Department of
Agriculture

Food and
Nutrition
Service

FNS-288

Infant Nutrition and Feeding

A Reference Handbook for Nutrition and Health Counselors in the WIC and CSF Programs

Note to the Reader on Using This Handbook

This handbook is for staff who provide nutrition education and counseling to the parents and guardians (termed "caregivers" in the text) of at-risk infants who participate in the Special Supplemental Food Program for Women, Infants, and Children (WIC) and the Commodity Supplemental Food Program (CSFP). This publication provides an overview of basic subjects related to infant nutrition and feeding and answers some common questions on the nutritional needs of infants, the development of feeding skills, breastfeeding, formula feeding, the introduction of foods, infant feeding practices, food selection and sanitary food preparation and storage, oral health, vegetarian nutrition, and some common gastrointestinal problems.

Since this publication primarily focuses on nutrition for the full-term infant without medical conditions, the reader is advised to consult with other trained health professionals or textbooks on pediatrics and/or pediatric nutrition for more detailed or advanced technical information on particular aspects of infant nutrition, assessment of an infant's nutritional status (including growth and development), and nutrition care for preterm, low-birthweight, or special needs infants or those with medical conditions. Note that the term "health care provider" in the text refers to the physician, dentist, nurse practitioner, registered nurse, or other health professional providing medical or dental care to the infant.

This handbook can assist staff in disseminating appropriate and accurate information to clients and in planning individual counseling sessions, group classes, and staff inservice training sessions. Chapter 7 summarizes key points taken from the whole text. Reference citations throughout the text are cited in full at the end of each chapter. A selected bibliography is provided for additional references on pediatric nutrition, nutrition care for children with developmental disabilities, lactation management, ethnic and cultural influences on infant nutrition and feeding, and parenting skills. For quick reference to topics, refer to the detailed index at the end of this handbook.

Every effort has been made to ensure the accuracy of the information in this handbook. The recommendations in this handbook are not designed to serve as an exclusive nutrition care plan or program for all infants. It is the responsibility of each staff person providing nutrition education to caregivers of infants to evaluate the appropriateness of nutrition recommendations in the context of an infant's nutritional and health status, lifestyle and other factors affecting that status, and any new developments in infant nutrition. If you have a question or are unsure about the appropriateness of a particular nutrition recommendation for a particular infant, consult with the infant's health care provider and someone with additional expertise in pediatric nutrition before making the recommendation.

We are interested in your comments on this handbook. Please help us by completing the READER RESPONSE on the last page.

September 1993

Contents

CHAPTER 1

Nutritional Needs of Infants

Introduction

Good nutrition is essential for the growth and development that occurs during an infant's first year. When developing infants are fed the appropriate types and amounts of foods, their health is promoted. Positive and supportive feeding attitudes and techniques demonstrated by the caregiver help infants develop healthy attitudes toward foods, themselves, and others.

Throughout the first year, many physiological changes occur that allow infants to consume foods of varying composition and texture. As an infant's mouth, tongue, and digestive tract mature, the infant shifts from being able to only suckle, swallow, and take in liquid foods, such as breast milk or infant formula, to being able to chew and receive a wide variety of foods. At the same time, infants progress from needing to be fed to feeding themselves. As infants mature, their food and feeding patterns must continually change.

For proper growth and development, an infant's diet must provide an adequate amount of essential nutrients obtained by consuming appropriate quantities and types of foods. During infancy, a period of rapid growth, nutrient requirements per pound of body weight are proportionally higher than at any other time in the life cycle. Although there are many nutrients known to be needed by humans, requirements have only been estimated for a limited number of these.

This chapter includes sections on nutrition assessment of infants, the Recommended Dietary Allowances (RDAs) and other estimated nutrient requirements for infants, and some background information on needs for specific nutrients during infancy.

Nutrition Assessment

In order to determine an infant's nutritional needs and the factors affecting these needs, and before developing a nutrition care plan for the infant, an accurate assessment of the infant's nutritional status must be performed. The nutrition assessment provides the nutrition or health counselor with important feeding practice and other information pertinent to an infant's health. Then, nutrition education sessions can be designed to encourage positive, appropriate feeding practices and, if necessary, recommend changes to correct inappropriate practices. By communicating periodically with a caregiver about an infant's nutritional needs in the first year of life, better care for the infant is assured.

The assessment should generally include an examination of:

- **Health and medical information.** Includes information gathered through chart review, caregiver interview, health care provider referral form(s), or other sources and may include history of chronic or acute illnesses or medical conditions, birth history, developmental disabilities, a clinical assessment identifying signs of nutritional deficiencies, and other pertinent information (CDA and SSDA, 1992).
- **Dietary intake data.** Includes information regarding the following (CDA and SSDA, 1992):
  - *Feeding history*—eating behaviors, feeding techniques, problems, and environment;
  - *Appetite and intake*—usual appetite, factors affecting intake such as preferences, allergies, intolerances, chewing/swallowing problems;
  - *Diet history*—breast milk and/or infant formulas used, age at introduction of solids, variety of solids provided, vitamin and mineral supplements given, and problems such as vomiting, diarrhea, constipation, and colic; also includes a 24-hour diet recall, food frequency, and/or a food record covering all foods given during day and night; and
  - *Socioeconomic background*—includes primary and other caregivers, food preparation and storage facilities, use of supplemental feeding and financial assistance programs, and ethnic and cultural influences on the diet.
- **Anthropometric Data.** Includes anthropometric measurements, e.g., height for length, weight for age, height for age.
- **Biochemical Data.** Includes data used to diagnose or confirm nutritional deficiencies or excesses (ADA, 1992); in the WIC

Program, hemoglobin or hematocrit or other hematological tests are performed to screen for iron deficiency anemia.

Recommended Dietary Allowances and Other Estimated Nutrient Requirements

The Recommended Dietary Allowances (RDAs), established by the Food and Nutrition Board of the National Academy of Sciences (NRC, 1989), are the standards most often used in the United States to determine whether dietary intake is adequate. Recommendations for feeding infants, from amounts of infant formula to the amounts and types of solid foods to introduce, are based primarily on the RDAs. The RDAs for infants are based on the nutrient content of foods consumed by healthy infants with normal growth patterns, the nutrient content of human breast milk, investigative research, and metabolic studies.

It is difficult to define precise nutrient requirements applicable to all infants because infants differ in the amount of nutrients ingested and stored, body composition, growth rates, and physical activity levels. Also, infants with medical problems or special nutritional needs (such as those with metabolic disorders, chronic diseases, injuries, premature birth, birth defects, other medical conditions, or on drug therapies) may have different nutritional needs than healthy infants. The RDAs for vitamins, minerals, and protein are set at levels thought to be high enough to meet the nutrient needs of most healthy infants, while energy allowances are based on average requirements for infants. An infant's typical intake, estimated from average daily intake over several days or longer, can be compared with the RDAs. Since the RDAs are intended to be used for groups, not individuals, they only serve as guidelines.

Background Information on Specific Nutrients

The following sections include basic background information on the function and food sources of, and some concerns regarding, major nutrients and nutrients considered to be of public health significance in the United States. Information is provided on the following five target nutrients (nutrients most likely to be deficient in the diets of the WIC-eligible population and with which adverse health and/or nutritional consequences are linked) of the WIC Program: protein, calcium, vitamins A and C, and iron.

For additional information on the function of, deficiency and toxicity symptoms associated with, and major food sources of the nutrients discussed below and other nutrients not discussed, refer to appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources of Nutrients, pages 162-166, and to the pediatric nutrition references in the Selected Bibliography, page 167. See appendix B, pages 156 to 161 for the following tables:

- Table 1: Recommended Dietary Allowances, 1989 (the RDAs for infants are subdivided into values for the first and second 6 months of life);
- Table 2: Median Heights and Weights and Recommended Energy Intake;
- Table 3: Recommended Allowances of Reference Protein and U.S. Dietary Protein;
- Table 4: Estimated Safe and Adequate Daily Dietary Intakes of Selected Vitamins and Minerals (this table specifies safe and adequate ranges for nutrients with data bases insufficient for developing an RDA but for which potentially toxic upper levels are known); and
- Table 5: Estimated Sodium, Chloride, and Potassium Requirements of Healthy Persons (only estimated minimum requirements are given).

Energy

Energy Needs

Infants need energy from food for activity, growth, and normal development. Energy comes from foods containing carbohydrate, protein, or fat. Energy needs are expressed as the number of kilocalories (often termed "calories") needed per unit of a person's body weight. A kilocalorie is a measure of how much energy a food supplies to the body, and is technically defined as the quantity of heat required to raise the temperature of 1 kilogram of water 1 degree Celsius.

An infant's energy or caloric requirement depends on many factors, including body size and composition, metabolic rate (the energy the body expends at rest), physical activity, size at birth, age, sex, genetic factors, energy intake, medical conditions, ambient temperature, and growth rate. Infants are capable of regulating their intake of food to consume the amount of kilocalories they need. Thus, caregivers are generally advised to watch their infants' hunger and satiety cues in making decisions about when and how much to feed them (see pages 47, 49, 75, 104 on hunger and satiety cues).

Recommended Energy Allowances

For infants, the recommended energy allowances are:

- From birth to 6 months old:*
  108 kilocalories **per kilogram** of body weight, or 49 kilocalories **per pound** of body weight
- Between 6 and 12 months old:
  98 kilocalories **per kilogram** of body weight, or 45 kilocalories **per pound** of body weight.

* These allowances apply to infants from birth to 6 months old who were born at term and who are healthy and free of disease.

These allowances are based on the average energy intake associated with normal growth among groups of infants. Modification of these allowances may be required based on data obtained from a nutrition assessment (CDA and SSDA, 1992). The kilocalories needed per unit of body weight decrease over the first year because infants older than 6 months grow more slowly. See table 1, page 4, for the estimated kilocalorie needs for infants of different ages and weights (for infants at the 10th, 50th, and 90th percentiles of weight for age) in the first year. See appendix B, table 2, for the Food and Nutrition Board's "Median Heights and Weights and Recommended Energy Intake."

Energy Intake and Growth Rate

A general indicator of whether an infant is consuming an adequate number of kilocalories per day is the infant's growth rate in length and weight. However, physical growth is a complex process that can be influenced by size and gestational age at birth, environmental and genetic factors, and medical conditions, in addition to dietary intake. An infant's growth rate can be evaluated by periodically plotting the infant's weight and length for age, and weight for length on National Center for Health Statistics (NCHS) growth charts throughout the first year of life (see appendix A, pages 148-155). Appendix A also includes basic instructions on how to collect, record, and interpret weight and length measures. Refer to DHHS (1981) and reference textbooks on pediatric nutrition or nutrition assessment for more detailed information on the anthropometric assessment of infants.

In general, most healthy infants double their birth weight by 4 to 5 months old and triple it by 12 months old. However, keep in mind that there are normal differences in growth between healthy breastfed and formula-fed infants. According to the Institute of Medicine (IOM, 1991): "During the first 2 to 3 months of lactation, exclusively breastfed infants generally stay at approximately the same weight-for-age percentile or gain weight at a slightly faster rate, although they ingest less energy than do formula-fed infants. After the third month, exclusively breastfed infants tend to follow lower weight-for-age and length-for-age percentiles. In general, those patterns are not altered by the introduction of solid foods." Guidelines provided by Lawrence (1989) (in a chapter on normal growth, failure to thrive, and obesity in the breastfed infant) can be consulted when evaluating the adequacy of growth of breastfed infants.

If an infant's growth rate on the charts appears to be abnormally slow or rapid, a nutrition assessment (including an evaluation of breastfeeding frequency and duration, formula dilution and intake, appropriate amount and types of solid foods, feeding skill development, etc.) should be performed to determine possible factors influencing the growth rate. In addition, the feeding relationship between the caregiver and infant can be evaluated to determine if negative interactions associated with feeding are contributing to an infant's abnormal growth rate. For background information on the feeding relationship refer to pages 29-30. Infants with abnormally slow or rapid growth rates, or recent weight loss, should also be referred to a health care provider

Table 1—Caloric Needs of Infants (Based on the 1989 Recommended Dietary Allowances)

Male Infants

Age (in months)	Weight [pounds (Kg)]						Range of Kcal/day Needed (percentiles)
	NCHS percentiles (weight for age)						10—50—90
	10		50		90		
Birth	6.2	(2.8)	7.3	(3.3)	8.4	(3.8)	302—356—410
1	7.6	(3.43)	9.4	(4.29)	11.3	(5.14)	370—463—554
2	9.0	(4.1)	11.4	(5.2)	13.6	(6.2)	442—561—668
3	10.5	(4.78)	13.2	(5.98)	15.7	(7.14)	515—645—770
4	11.9	(5.4)	14.7	(6.7)	17.4	(7.9)	582—722—852
5	13.2	(6.0)	16.1	(7.3)	18.7	(8.5)	647—787—916
6	14.5	(6.61)	17.3	(7.85)	20.0	(9.10)	712—846—981
7	15.6	(7.1)	18.3	(8.3)	21.1	(9.6)	703—822—950
8	16.7	(7.6)	19.4	(8.8)	22.2	(10.1)	752—871—1,000
9	17.4	(7.9)	20.3	(9.2)	23.1	(10.5)	782—911—1,040
10	18.3	(8.3)	20.9	(9.5)	24.0	(10.9)	822—941—1,079
11	18.9	(8.6)	21.8	(9.9)	24.6	(11.2)	851—980—1,109
12	19.4	(8.8)	22.4	(10.2)	25.3	(11.5)	871—1,010—1,139

Female Infants

Age (in months)	Weight [pounds (Kg)]						Range of Kcal/day Needed (percentiles)
	NCHS percentiles (weight for age)						10—50—90
	10		50		90		
Birth	5.7	(2.6)	7.0	(3.2)	7.9	(3.6)	280—345—388
1	7.1	(3.22)	8.8	(3.98)	10.2	(4.65)	347—429—501
2	8.6	(3.9)	10.3	(4.7)	12.3	(5.6)	420—507—604
3	9.8	(4.47)	11.9	(5.40)	14.1	(6.39)	482—582—689
4	11.2	(5.1)	13.2	(6.0)	15.6	(7.1)	550—647—765
5	12.3	(5.6)	14.7	(6.7)	17.2	(7.8)	604—722—841
6	13.5	(6.12)	15.9	(7.21)	18.4	(8.38)	660—777—904
7	14.5	(6.6)	16.9	(7.7)	19.6	(8.9)	653—762—881
8	15.4	(7.0)	18.0	(8.2)	20.7	(9.4)	693—812—931
9	16.1	(7.3)	18.9	(8.6)	21.6	(9.8)	723—851—970
10	16.9	(7.7)	19.6	(8.9)	22.4	(10.2)	762—881—1,010
11	17.4	(7.9)	20.2	(9.2)	23.3	(10.6)	782—911—1,049
12	18.0	(8.2)	20.9	(9.5)	24.0	(10.9)	810—941—1,079

for assessment of possible medical conditions or developmental delays that may affect intake and/or growth.

Carbohydrates

Carbohydrates fall into these major categories: simple sugars or monosaccharides (e.g., glucose, galactose, fructose, and mannose), double sugars or disaccharides (e.g., sucrose, lactose, and maltose), and complex carbohydrates or polysaccharides (e.g., starch, dextrins, glycogen, and indigestible complex carbohydrates such as pectin, lignin, gums, and cellulose). Dietary fiber is another name for indigestible complex carbohydrates of plant origin (these are not broken down by intestinal digestive enzymes).

Functions

Carbohydrates are necessary in the infant's diet because they:

- Supply food energy for growth, body functions, and activity;
- Allow protein in the diet to be used efficiently for building new tissue;
- Allow for the normal use of fats in the body; and
- Provide the building blocks for some essential body compounds.

Carbohydrates serve as primary sources of energy to fuel bodily activities while protein and fat are needed for other essential functions in the body, such as building and repairing tissues. There is no RDA for carbohydrates or dietary fiber.

Sources

The major type of carbohydrate normally consumed by young infants is lactose, the carbohydrate source in human milk and cow's milk-based infant formula. Lactose-free infant formulas, such as soy-based infant formulas, provide carbohydrates in the form of sucrose, corn syrup, or corn syrup solids. These formulas are prescribed to infants who cannot metabolize lactose or galactose, a component of lactose, or are allergic to cow's milk protein. Some specialty infant formulas contain other carbohydrates in the form of modified corn starch, tapioca dextrin, or tapioca starch.

In later infancy, infants derive carbohydrates from additional sources including cereal and other grain products, fruits, and vegetables. Infants who consume sufficient breast milk or infant formula, and a well-balanced diet in later infancy, would meet their dietary need for carbohydrates.

Concern About Dietary Fiber Intake by Infants

Dietary fiber is found in legumes, whole-grain products, and fruits and vegetables. Concern has been expressed that a diet high in dietary fiber may fill an infant's stomach and prevent consumption of sufficient kilocalories or essential nutrients for growth (CON, 1981; CON, 1983). This may be a problem primarily with infants kept on strict vegetarian diets, which would tend to be very high in fiber (CON, 1981; CON, 1985). Another concern is that high-fiber diets may decrease an infant's absorption of essential minerals from food, but more research is needed in this area (CON, 1981; CON, 1985; Pipes, 1989). These concerns have lead to the general recommendation that older infants be fed a variety of appropriate solid foods, not a diet consisting primarily of high-fiber, low-calorie foods. See pages 117-121 for more information on vegetarian diets.

Sorbitol In Juices

Some fruit juices, such as apple, pear, and prune, contain a significant amount of sorbitol, a type of carbohydrate called a "sugar alcohol." When such fruit juices are consumed in excessive amounts by children, they may cause gastrointestinal symptoms such as diarrhea, abdominal pain, or bloating (CON, 1991; Silverman and Roy, 1983; Greene and Ghishan, 1983). Sugar alcohols create a laxative effect due to their slow and incomplete absorption in the gastrointestinal tract (NRC, 1989). For this and other reasons, caregivers should avoid feeding their infants excessive amounts of fruit juice (see pages 91-92 on fruit juice).

Carbohydrates and Tooth Decay

See pages 113-114 for information on the role of certain carbohydrates in tooth decay.

Protein

All proteins are combinations of about 20 common amino acids. Some of these amino acids are manufactured in the body when adequate amounts of protein-rich foods are eaten. Nine amino acids that are not manufactured by the human body and must be supplied by the diet are called "essential" or "indispensable" amino acids. These include: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Two other amino acids, cystine and tyrosine, are considered essential for the preterm and young term infant because enzyme activities involved in their synthesis are immature (CON, 1993).

Functions

Infants require high quality protein from breast milk, infant formula, and/or other food to:

- Build, maintain, and repair new tissues, including tissues of the skin, eyes, muscles, heart, lungs, brain, and other organs;
- Manufacture important enzymes, hormones, antibodies, and other components; and
- Perform very specialized functions in regulating body processes.

Protein also serves as a potential source of energy if the diet does not furnish sufficient kilocalories from carbohydrate or fat. As with energy needs, protein needs for growth per unit of body weight are initially high and then decrease with age and as growth rate slows down.

RDA for Protein

For the RDA for protein in grams of protein required per kilogram of body weight, see appendix B, table 3: Recommended Allowances of Reference Protein and U.S. Dietary Protein. The RDA for protein was devised assuming that infants are consuming an adequate number of kilocalories from carbohydrates and fat in their food so that protein is not used for energy. Modification of the RDA for protein may be required based on data obtained from a nutrition assessment (CDA and SSDA, 1992).

Sources

Breast milk and commercial infant formula, if consumed in amounts necessary to meet energy needs, provide sufficient protein to meet a young infant's needs. In later infancy, sources of protein in addition to breast milk and commercial infant formula include meat, poultry, fish, egg yolks, legumes, cereals and other grain products, cheese, and yogurt. When an infant starts receiving a substantial portion of energy intake from foods other than breast milk or infant formula, these other foods need to provide adequate protein. See pages 40-41 for information on the protein in human milk, and pages 94-97 for information on introducing protein-rich foods into an infant's diet.

Proteins in animal foods contain sufficient amounts of all the essential amino acids to meet protein requirements. In comparison, plant foods contain low levels of one or more of the essential amino acids (Pemberton, et. al, 1988). However, when plant foods low in one essential amino acid are eaten on the same day with an animal food or other plant foods that are high in that amino acid (e.g., legumes such as pureed kidney beans [low in methionine, high in lysine] and grain products such as mashed rice [high in methionine, low in lysine]), sufficient amounts of all the essential amino acids are made available to the body. The protein eaten from the two foods would be equivalent to the high quality protein found in animal products. See pages 118-119 regarding concerns about protein in vegetarian diets.

Protein Deficiency

In the United States, very few infants suffer from true protein deficiency. In developing countries, infants who are deprived of adequate types and amounts of food for long periods of time may develop kwashiorkor, resulting principally from a protein deficiency; marasmus, resulting from a deficiency of kilocalories; or marasmus-kwashiorkor, resulting from a deficiency of kilocalories and protein. In this country, cases of kwash-

iorkor are rare but have been reported in the following situations (Chase et al., 1980; John et al., 1977; Van Duzen et al., 1969):

- An infant who is kept on highly diluted formula either in error or after several bouts of diarrhea or vomiting;
- An infant who is on a diet entirely excluding all types of milk; and
- A child who lives in extreme poverty and is fed very few protein-rich foods.

Protein-rich Foods and Addition of Water to the Diet

See pages 17 and 97 for information on offering water to infants who consume protein-rich foods.

Lipids

Lipids are a group of substances including fats, oils, and fat-like substances, such as cholesterol. Fatty acids are the major constituent of many lipids. Fatty acids that must be provided in the diet to maintain health are called essential fatty acids. Although the Food and Nutrition Board has not established an RDA for lipids for infants, the Board acknowledges that small amounts of linoleic acid, an essential fatty acid, must be provided in the diet. Arachidonic acid, a fatty acid derived from linoleic acid, is considered an essential fatty acid only when linoleic acid is lacking in the diet. Linolenic acid is also traditionally classified as an essential fatty acid.

Functions

Infants require lipids in their diets because of their role in:

- Supplying a major source of energy; fat supplies between 40 and 50 percent of the energy consumed in infancy (Pipes, 1989);
- Promoting the accumulation of stored fat in the body which serves as insulation to reduce body heat loss, and as padding to protect body organs;
- Allowing for the absorption of the fat-soluble vitamins A, D, E, and K; and
- Providing essential fatty acids that are required for normal brain development, healthy skin and hair, normal eye development, and for resistance to infection and disease.

Sources

Breast milk and infant formula are important sources of lipids, including essential fatty acids, during infancy. Breast milk provides approximately 30 to 55 percent of its kilocalories from lipids (Lawrence, 1989); reasons for this wide range are described on page 40. Commercial infant formulas provide approximately 50 percent of their kilocalories as fat (Pipes, 1989). Human milk contains 3 to 7 percent of its kilocalories as linoleic acid, while most commercial infant formulas contain more than 10 percent (CON, 1993). The American Academy of Pediatrics recommends that infant formulas provide at least 2.7 percent of their kilocalories as linoleic acid, with between 30 and 54 percent of their kilocalories coming from fat in general (CON, 1976). Manufacturers of commercial infant formulas add blends of vegetable oils, which are high in linoleic acid, to improve essential fatty acid content. Food sources of lipids in the older infant's diet, besides breast milk and infant formula, include meats, cheese and other dairy products, egg yolks, and any fats or oils added to prepared foods.

Fat and Cholesterol in Infant Diets

There is agreement among the American Academy of Pediatrics, the American Heart Association, the National Institutes of Health Consensus Conference on Lowering Blood Cholesterol, and the National Cholesterol Education Program that fat and cholesterol should not be restricted in the diets of infants (Weidman et al., 1983; Consensus Conference, 1985; CON, 1986b and 1992; NCEP, 1990; NCEP, 1991). Further, the American Academy of Pediatrics recommends that "no restrictions should be placed on the fat and cholesterol content of the diet of infants from birth to 2 years of age, a period of rapid growth and development and high nutritional requirements" (CON, 1992). The fast growth of infants requires an energy-dense diet with a higher percentage of kilocalories from fat than is needed by older children.

Cholesterol performs a variety of functions in the body but is not an essential nutrient because it is manufactured by the liver. Cholesterol is not added to infant formulas whereas human milk contains a significant amount of cholesterol. The

cholesterol in breast milk is thought to be important for the development of the central nervous system and of bile acid synthesis in infants (Jelliffe, 1975; Lawrence, 1989).

In recent years, there has been interest in whether the cholesterol content of breast milk has a beneficial or adverse effect on later development of atherosclerosis. It has been suggested that breast milk's high level of cholesterol stimulates the development of enzymes necessary to prepare the infant's body to process cholesterol more efficiently in later life (Jelliffe, 1975). Although animal studies have failed to provide clear-cut evidence that the mode of infant feeding affects blood cholesterol later in life (Hamosh, 1988), it has been suggested that dietary cholesterol may affect the mechanism of handling cholesterol in the infant's body (Mott et al., 1990). Human studies (Fomon et al., 1984; Friedman and Goldberg, 1975; Hodgson et al., 1976; Huttunen et al., 1983; Marmot et al., 1980) show only small and inconsistent differences in serum cholesterol levels between formula-fed and breastfed children and young adults (IOM, 1991). Thus far prospective clinical studies on the effect of dietary cholesterol modification during infancy on cholesterol levels in the blood and development of coronary heart disease 40 to 50 years later have not been performed (Kwiterovich, 1986). Therefore, the specific effects of the types of infant feeding on the development of atherosclerosis have not yet been determined.

Vitamin D

Functions

Vitamin D, a fat-soluble vitamin, is essential for the proper formation of the bones and for the use of calcium and phosphorus in the body.

Sources

Vitamin D is manufactured in the skin by the action of ultraviolet light (from the sun) on chemicals naturally present in the skin. Thus, the requirement for dietary vitamin D depends on the amount of exposure an infant gets to the sun. See page 164 for dietary sources.

Vitamin and Mineral Supplements

Caregivers should not supplement their infants' diets with vitamins or minerals during the first year of life unless they are prescribed by a health care provider. If a supplement is prescribed, it is important that only the dosage prescribed be given to the infant and the supplement bottle be kept out of reach of infants and children. Excessive amounts of certain vitamins and minerals, fed in the form of drops, can be toxic to infants. Similarly, an infant or child who finds and opens a vitamin-mineral supplement bottle could easily consume a toxic amount.

Since commercial infant formulas are fortified with vitamin D, infants consuming appropriate amounts of formula receive adequate amounts of vitamin D. Human milk contains only small amounts of this vitamin. However, exclusive breastfeeding results in normal bone mineral content when the mother's vitamin D status is adequate and the infant is regularly exposed to sunlight (IOM, 1991). Breastfed infants require approximately 30 minutes of exposure to sunlight per week if wearing only a diaper, or 2 hours per week if fully clothed without a hat, to maintain normal blood levels of vitamin D (Specker et al., 1985). Dark-skinned infants require a greater exposure to sunshine to initiate the synthesis of vitamin D in the skin (Clemens et al., 1982). *Note: Caregivers should be careful not to overexpose their infants and children to sunshine, given the risks associated with overexposure to the sun and sunburn. They can inquire with their health care providers regarding safety precautions for infants and children exposed to the sun.*

If the infant or mother is not exposed regularly to sunlight, or if the mother's intake of vitamin D is low, supplements for the breastfed infant may be indicated (IOM, 1991). The Food and Nutrition Board, National Academy of Sciences, recommends that breastfed infants who are not exposed to sunlight receive a daily supplement

of vitamin D (5 to 7.5 micrograms or 200 to 300 IU per day) (NRC, 1989). Health care providers can advise mothers of breastfed infants whether vitamin D should be supplemented.

Vitamin D Deficiency

An infant not receiving sufficient vitamin D through exposure to the sun or through the diet can develop a deficiency. Vitamin D deficiency leads to inadequate intestinal absorption of calcium and phosphorus resulting in improper bone formation and tooth mineralization. The disease rickets can result from vitamin D deficiency. *Symptoms of rickets include the following* (Robinson et al., 1986):

- Softening and malformation of the bones (which can lead to, for example, bowing of the legs, softening of the skull, narrowing of the pelvis, and spinal curvature);
- Poor muscle development;
- Irritable and restless behavior; and
- Enlargement of the joints in the wrists, knees, and ankles.

Cases of rickets have been reported among infants on vegan (completely vegetarian) diets or breastfed by mothers on vegan diets, and infants who receive little exposure to the sun (Bachrach et al., 1979; Edidin et al., 1980; Hayward et al., 1987; Lawrence, 1989). See pages 117-121 for a discussion of vegan diets. Dark-skinned breastfed infants living in areas where it is often cloudy and there is little sunlight may also be at risk of developing rickets (Bachrach et al., 1979; Lawrence, 1989).

Vitamin A

Vitamin A, a fat-soluble vitamin, refers to a group of compounds including preformed types of the vitamin found in animal products, and carotenes, precursors of vitamin A, found in plants.

Functions

Vitamin A is essential for:

- The formation and maintenance of healthy skin, hair, and mucous membranes;
- Proper vision;
- Growth and development; and
- Healthy immune and reproductive systems.

Sources

Breast milk and commercial infant formula are major food sources of vitamin A. Additional sources of vitamin A or carotenes for infants on solid foods include egg yolks; deep green or yellow vegetables and fruits (e.g., broccoli, spinach, greens, winter squash, sweet potato, apricots, cantaloupe, nectarine, and commercially-prepared vitamin A-rich baby food fruits and vegetables such as jarred apricots and carrots); liver, and whole and fortified milk products. Some infants may have hypersensitivity (allergic) reactions to certain fruits or vegetables. See pages 92-93 on precautions that caregivers should follow when introducing fruits and vegetables.

Vitamin A Deficiency

Although rare in the United States, vitamin A deficiency is a major nutritional problem in the nonindustrialized world (FAO, 1988). This deficiency can result from insufficient vitamin A intake or chronic fat malabsorption and it can lead to damage, of varying severity, to the eyes, poor growth, loss of appetite, increased susceptibility to infections, and skin changes.

Vitamin E

Functions

Vitamin E, a fat-soluble vitamin, protects vitamin A and essential fatty acids in the body and prevents the breakdown of tissues.

Sources

Infants receive vitamin E from breast milk and commercial infant formula. Other vitamin E sources for the older infant include fish, soybeans, vegetable oils and their products, fortified or whole-grain cereals, and some fruits and vegetables (e.g., green leafy vegetables, pumpkin, apple, apricots, nectarine, peaches). Vitamin E can be lost through processing and cooking.

Vitamin K

Functions

Vitamin K, a fat-soluble vitamin, is necessary for proper blood clotting.

Sources

Although this vitamin is manufactured by bacteria normally found in the intestine, this process is not fully underway early in an infant's life. Therefore, infants born in a hospital are usually given vitamin K at birth. Infants fed an adequate amount of commercial infant formula receive sufficient vitamin K. Since breast milk is normally low in vitamin K, exclusively breastfed infants born at home or outside of a hospital are at risk of developing a fatal brain hemorrhage due to vitamin K deficiency. Therefore, the Food and Nutrition Board, National Academy of Sciences, recommends a supplement of vitamin K for any newborn fully breastfed infant born at home who did not receive vitamin K at birth (NRC, 1989). See page 165 for dietary sources.

Vitamin C

Functions

The major functions of Vitamin C (ascorbic acid), a water-soluble vitamin, include the following:

- Forming collagen, a protein that gives structure to bones, cartilage, muscle, blood vessels, and other connective tissues;
- Helping to maintain capillaries, bones, and teeth;
- Healing wounds;
- Playing a role in the body's ability to resist infection; and
- Enhancing the absorption of iron.

Sources

Breast milk and commercial infant formulas are major food sources of vitamin C. Additional vitamin C sources include vegetables and fruits (either home-prepared or commercially prepared vitamin C-fortified baby foods such as jarred baby food fruits), commercial infant juices, and regular fruit and vegetable juices naturally high in or fortified with vitamin C. Cooking home-prepared vegetables (or fruits if they need to be cooked) for the minimum time required to process them reduces destruction of vitamin C in the food. See pages 92-93 on precautions that caregivers should follow when introducing vegetables and fruits.

Vitamin C Deficiency

Vitamin C deficiency can eventually lead to scurvy, a serious disease with the following symptoms in infants: tenderness and swelling, mostly at the knees or ankles; pale skin; loss of appetite; irritability; hemorrhaging gums; and bleeding in the skin or from mucous membranes (Shils and Young, 1988). Although incidence of scurvy among infants in the United States is low (Robinson, et. al, 1986), scurvy has been seen among infants fed diets consisting exclusively of cow's milk (NRC, 1989). Cow's milk, evaporated milk, and goat's milk contain very little vitamin C.

Vitamin B_{12}

Functions

Vitamin B_{12}, a water-soluble vitamin, is necessary for healthy blood cells and proper functioning of the nervous system.

Sources

An infant's vitamin B_{12} stores at birth generally supply his or her needs for approximately 8 months. Infants receive vitamin B_{12} from breast milk and commercial infant formulas and, in later infancy, from meats, fish, poultry, eggs, and dairy products. Infants consuming appropriate amounts of commercial infant formula receive adequate amounts of this vitamin.

Vitamin B_{12} Deficiency, Breastfed Infants, and Vegetarian Diets

Vitamin B_{12} concentrations in breast milk, and thus the exclusively breastfed infant's B_{12} intake, depend on the mother's B_{12} intake and stores. Breastfed infants whose mothers follow strict vegetarian (vegan) diets or eat very few animal foods are at risk for developing vitamin B_{12} deficiency (Close, 1983; Davis et al., 1981; Gambon et al., 1986; Higginbottom et al., 1978; Rendle-Short et al., 1979; Sklar, 1986; Specker et al.,

1988). Vitamin B_{12} deficiency can lead to megaloblastic anemia and, if severe, to neurologic problems. The Food and Nutrition Board, National Academy of Sciences, recommends supplementation of this vitamin (2.6 micrograms/day) for nursing women consuming vegan diets in order to meet the mother's and nursing infant's needs (NRC, 1989).

Vitamin B_{12} would also be a concern for an infant on a strict vegetarian or vegan diet. See page 119 for more information on vitamin B_{12} in vegetarian and vegan diets. A health care provider can be consulted for advice on whether vitamin B_{12} should be supplemented.

Folate

Functions

Folate, a water-soluble vitamin also called folic acid or folacin, is required for cell division and is thus important for growth and development and for healthy blood cells. This vitamin aids in the formation of genetic material within every body cell.

Sources

Infants receive folate from breast milk, commercial infant formula, fruit or vegetable juice, fruits and vegetables, legumes, grain products, lean beef, eggs, veal, seafood, and liver. Folate can be lost from foods during preparation, cooking, or storage.

Vitamin B_6 (Pyridoxine)

Functions

Vitamin B_6 (pyridoxine), a water-soluble vitamin, helps the body use protein to build tissues and aids in the metabolism of fat. The need for this vitamin is directly related to protein intake; as protein intake increases, the need for vitamin B_6 in the diet increases.

Sources

Food sources of vitamin B_6 include breast milk, commercial infant formula, poultry, fish, liver, meat, egg yolk, some legumes (e.g., soybeans), whole-grain and fortified or enriched grain products, potatoes, sweet potatoes, spinach, and prunes.

Thiamin (Vitamin B_1)

Functions

Thiamin (vitamin B_1), a water-soluble vitamin, helps the body release energy from carbohydrates during metabolism and plays a vital role in the normal functioning of the nervous system.

Sources

Food sources of thiamin include breast milk, commercial infant formula, whole-grain and fortified or enriched cereals and other grain products, organ meats, lean cuts of pork, fish, corn, peas, legumes, and melon.

Thiamin Deficiency

Thiamin deficiency can occur in breastfed infants of thiamin-deficient mothers (CON, 1993). See appendix C, page 165, for symptoms of thiamin deficiency.

Riboflavin (Vitamin B_2)

Functions

Riboflavin (vitamin B_2), a water-soluble vitamin, helps the body release energy from protein, fat, and carbohydrates during metabolism.

Sources

Food sources of riboflavin include breast milk, commercial infant formula, dairy products, whole-grain and fortified or enriched cereals and other grain products, meat and poultry, fish, and some vegetables (such as broccoli, spinach, asparagus, turnip greens, and sweet potatoes).

Riboflavin Deficiency Associated with Macrobiotic Diets

Riboflavin has been found to be deficient in severely restricted macrobiotic diets (see page 117 for a definition of these diets); however, it is not a problem in other forms of vegetarianism (CON, 1993; Bergan and Brown, 1980). Riboflavin deficiency can lead to growth inhibition; deficiency symptoms include skin changes and dermatitis, anemia, and lesions in the mouth.

Niacin

Functions

Niacin, a water-soluble vitamin, helps the body release energy from protein, fat, and carbohydrates during metabolism. The need for niacin is normally met in part by the body's conversion of the amino acid, tryptophan, in the diet to niacin.

Sources

Food sources of niacin include breast milk, commercial infant formula; enriched, fortified, and whole-grain cereals and other grain products, meat, poultry, and fish. Niacin can be formed in the body from the tryptophan in these foods: meat, poultry, cheese, yogurt, fish, and eggs.

Calcium

Functions

Calcium, a mineral, plays an important role in bone and tooth development, blood clotting, and maintaining healthy nerves and muscles.

Sources

An infant can obtain sufficient calcium by consuming adequate amounts of breast milk or commercial infant formula. Older infants can obtain additional calcium from other foods including yogurt, cheese, grain products, some green leafy vegetables (such as broccoli, kale, collards, and turnip greens), lime-processed tortillas, and tofu (if made with calcium sulfate as shown on the food label).

The absorption and use of calcium in the body is affected by the presence of other nutrients, such as vitamin D which must be available in the body for an infant to retain and use the calcium consumed.

Calcium Deficiency and Vegetarian Diets

Infants on certain strict vegetarian diets may be at risk for developing a calcium deficiency. Use of commercial soy-based infant formulas, which are fortified with calcium, is usually recommended for infants whose caregivers decide to place them on a vegan diet low in breast milk.

Soy beverages (sometimes called soy drinks or soy milks) available in specialty stores typically do not provide sufficient calcium for infants and thus are not recommended for infants (see page 118 for more information on soy beverages).

Calcium Deficiency and Lead Poisoning

Calcium deficiency is related to increased blood lead levels and perhaps increased vulnerability to the adverse effects of lead in the body (Mahaffey, 1981; Mahaffey and Michaelson, 1980).

Iron

Functions

Iron, a mineral, is needed by infants for proper growth and for the formation of healthy blood cells. This mineral is a vital component of hemoglobin, the part of red blood cells that carries oxygen throughout the body; of myoglobin, the part of muscle cells which stores oxygen; and of many enzymes in the body. Dietary iron is needed to prevent iron-deficiency anemia.

Sources

Most full-term infants are born with adequate iron stores that are not depleted until about 4 to 6 months old. In comparison, preterm infants and twins have lower iron stores at birth and, with their rapid growth rate, may deplete their iron stores by 2 to 3 months (CON, 1993; Dallman, et. al, 1980).

Sources of iron for infants include breast milk and iron-fortified infant formula, iron-fortified cereal, meat, poultry, fish, liver, legumes, enriched, fortified, or whole-grain products, and some vegetables and fruits (e.g., dried fruits, lima beans, spinach). The ability to absorb the iron in food depends on the infant's iron status and the form of iron in the food. Absorption of iron from the diet is relatively low when body iron stores are high and absorption may increase when iron stores are low (Bothwell et al., 1979).

Iron in food occurs in two major forms:

- **Heme iron,** the form found primarily in animal tissues, including red meat, liver, poultry, and fish. This form is well absorbed

into the body. Commercial baby food plain meats contain more heme iron than mixed vegetable/meat dinners.

- **Nonheme iron**, the form found in breast milk, infant formula, iron-fortified cereals, grain products, legumes, fruits, and vegetables. Infants receive most of the iron in their diets as nonheme iron. This form is not as well absorbed into the body as heme iron and its absorption can be affected by other foods in the same feeding or meal. Vitamin C-rich foods or meat, fish, or poultry in a meal increase the absorption of nonheme iron. Thus, it is recommended to serve a vitamin C source (such as breast milk, iron-fortified infant formula, or vitamin C-rich fruit juices or foods) at the same meal as iron-fortified cereals or other fortified grain products or legumes. Dairy products reduce the absorption of iron.

Meeting Iron Requirements of Breastfed and Formula-Fed Infants

The iron requirement for infants from birth through 6 months is met when adequate amounts of breast milk or iron-fortified infant formula are consumed. Recommendations to prevent iron deficiency from developing from birth through 12 months old are generally based on the type of milk consumed, as follows.

Breastfed Infants Although breast milk is low in iron, the iron is well absorbed and utilized by the infant's body. Iron deficiency is uncommon in breastfed infants during their first 6 months (Duncan et al., 1985, Garry et al., 1981; Owen et al., 1981; Picciano and Deering, 1980; Saarinen and Siimes, 1979; Saarinen et al., 1977). Thus, additional iron is not generally required for exclusively breastfed infants less than 6 months old. However, breastfed infants younger than 6 months old who are fed supplemental foods may develop iron deficiency (Woodruff et al., 1977; Oski and Landaw, 1980).

To prevent iron deficiency in full-term breastfed infants, it is recommended that iron-rich or iron-fortified foods (e.g., iron- fortified cereal) or an iron supplement be given by 6 months (CON, 1993; IOM, 1991), or earlier, if solid foods or infant formula are introduced before 6 months (IOM, 1991).

Formula-Fed Infants Infants who are not breastfed need an additional source of iron to meet their iron needs over the first 6 months of life. Iron-fortified infant formula, a good source of iron, is recommended for nonbreastfed infants. Low-iron infant formulas do not provide an adequate amount of iron to infants, place infants at risk of developing iron deficiency, and are not recommended for use during the first year of life (CON, 1993; 1992; 1989) (see page 71 for the few medical conditions for which low-iron infant formula is indicated). Although some caregivers may state that the iron in infant formula causes gastrointestinal problems, such as constipation, diarrhea, or vomiting, controlled studies indicate that infants consuming iron-fortified infant formulas are no more likely to suffer those symptoms than infants consuming low-iron formulas (CON, 1989; Nelson et al., 1988; Oski, 1980). It is recommended that formula-fed infants start iron-fortified cereal at 4 to 6 months old. Additional iron sources, such as the cereal, become important as the older infant's intake of formula gradually decreases and solid food intake increases.

Whole Cow's Milk Whole cow's milk contains relatively little iron and the iron it does contain is also poorly absorbed by infants. Whole cow's milk can promote the development of iron-deficiency anemia by causing microscopic gastrointestinal bleeding and nutritionally significant blood loss in infants (CON, 1992). Consumption of whole cow's milk also inhibits an infant's ability to absorb iron from different foods consumed, including iron-fortified infant cereals (CON, 1992). For these reasons and others, whole cow's milk is not recommended for infants less than 12 months old (CON, 1992). See pages 72-74 for additional information on whole and reduced fat cow's milk.

Iron Deficiency

The WIC Program screens for iron deficiency (deficiency in iron stores) using hematological tests, such as the hemoglobin and hematocrit tests. Hemoglobin is the iron-containing, oxygen-carrying protein in the blood. Hematocrit refers to the packed cell volume (volume of red blood cells and other particulate elements in the blood), that is, the percentage the red cell volume is of a total unit volume of blood. The symptoms of iron deficiency include anemia, malabsorption

of food, irritability, anorexia, pallor, and lethargy (Walker and Hendricks, 1985). There is also concern that iron deficiency may have detrimental effects on learning, behavior, and brain function. Studies have shown that iron deficiency in infants and older children may be associated with irreversible behavioral abnormalities and abnormal functioning of the brain (Walter et al., 1988; Lozoff et al., 1987; Pollitt et al., 1988; Dobbing, 1990). Iron deficiency is related to increased blood lead levels and perhaps increased vulnerability to the adverse effects of lead in the body (Mahaffey, 1981; Mahaffey and Michaelson, 1980).

If an infant is found to have a low hematocrit or hemoglobin level based on blood testing, it is appropriate to assess the infant's diet and refer him or her to a health care provider for further assessment of iron status and treatment.

Zinc

Functions

Zinc, a mineral which is a component of many enzymes in the body, is involved in most metabolic processes. Zinc plays a role in the formation of protein in the body and thus assists in wound healing, blood formation, and general growth and maintenance of all tissues. This nutrient is also important for taste perception and a healthy immune system.

Sources

Infants obtain zinc from breast milk, commercial infant formula, meat, poultry, liver, egg yolks, cheese, yogurt, legumes, and fortified or whole-grain cereals and other grain products. Meat, liver, and eggs are good sources of available zinc, whereas whole-grain products contain the element in a less available form (NRC, 1989). Breast milk is considered to be a good source of zinc (Lönnerdal et al., 1984) and the level of zinc in the milk does not appear to be influenced by the mother's diet (Lönnerdal et al., 1981). In addition to breast milk or commercial infant formula, other food sources of zinc help to meet an infant's zinc needs after 6 months old.

Zinc in Vegetarian Diets

Some vegetarian diets may be deficient in zinc. See page 120 for information on zinc in vegetarian diets.

Zinc and Lead Poisoning

Zinc deficiency is related to increased blood lead levels and perhaps increased vulnerability to the adverse effects of lead in the body (Mahaffey, 1981; Mahaffey and Michaelson, 1980). See appendix C, page 164, for deficiency signs resulting from zinc deficiency.

Fluoride

In 1994, leading authorities in pediatric dentistry and nutrition plan to review existing guidelines on dietary fluoride supplementation. It is anticipated that recommended levels of supplementation will be reduced for infants and young children. This new information may affect the recommendations given in this section.

Functions

Fluoride, although not considered an essential nutrient, is a beneficial mineral which, if consumed at appropriate levels, decreases the susceptibility of the teeth to dental caries (tooth decay) (NRC, 1989). When consumed in the diet or allowed to come in contact with the teeth, fluoride is incorporated into the mineral portion of the teeth. Once fluoride is an integral part of the tooth structure, teeth are stronger and more resistant to decay.

Sources

Fluoride is present in small but varying concentrations in water supplies and in plant and animal foods (NRC, 1989). See below (under "recommendations") for information on fluoride in breast milk and commercial infant formula. Since continued exposure to appropriate levels of fluoride throughout one's lifetime is effective in reducing the prevalence of dental caries, many

communities add fluoride to the water supply if it is naturally low in that mineral. Health care providers can offer advice on fluoride to caregivers of breastfed or formula-fed infants living in areas with or without fluoridated water.

If the fluoride content of the home drinking water is unknown, the water should be tested. Some health departments will test water for fluoride for free, if the request is signed by a dental or medical health care provider. Private laboratories can also test for fluoride. Fluoride may not be specifically added to bottled waters, but they may contain some fluoride. Thus, caregivers using bottled water (other than distilled water) to mix formula and for drinking and food preparation should have it tested for fluoride content. Otherwise it would be impossible for the health care provider to adequately assess the amount of fluoride the infant is ingesting.

Food preparation practices affect the fluoride content of home-prepared baby foods (e.g., cooking in fluoridated water (Marier and Rose, 1966; Martin, 1951) or in pots treated with Teflon, a fluoride-containing polymer, can increase the fluoride content, whereas an aluminum surface can reduce it (Full and Parkins, 1975)). Commercial baby food in jars is generally prepared with nonfluoridated water.

Recommendations on Fluoride for Infants

Recommendations on fluoride vary depending on whether an infant is breastfed, bottle-fed, and/or consuming solid foods prepared with fluoridated water.

Considerations for Breastfed Infants The benefit of fluoride supplementation in the exclusively breastfed infant is controversial because of the lack of evidence that fluoride supplementation in the first 6 months of life alters the prevalence of dental caries in the permanent teeth (CON, 1993). Evidence shows that human milk contains little fluoride even in areas with fluoridated water supplies (Singer and Ophaug, 1979; USDHEW, 1969). However, rates of dental caries are comparable between breastfed and formula-fed infants living in areas where the water is adequately fluoridated (Walton and Messer, 1981). The American Academy of Pediatrics acknowledges that fluoride supplementation may be beneficial when initiated at 6 months old for breastfed infants (CON, 1993). Note that fluoride supplementation may not be appropriate for partially breastfed infants consuming either fluoridated drinking water or infant formula mixed with fluoridated water. *Given the above controversies and concerns, caregivers of exclusively or partially breastfed infants should consult with their infants' health care provider for advice on fluoride.*

Considerations for Formula-Fed Infants The amount of fluoride in commercial concentrated or powdered infant formula depends on the amount of fluoride in the formula and in the water used for mixing. Ready-to-feed infant formulas are manufactured with nonfluoridated water. Infants receiving ready-to-feed infant formula, or concentrated or powdered infant formula in areas where the water is not fluoridated, may receive little or no fluoride. Note that research suggests that soy-based ready-to-feed and diluted liquid concentrate formulas may provide a higher than normally expected quantity of fluoride which, in combination with a fluoride supplement, would provide more than the recommended daily fluoride intake for infants (McNight-Hanes et al., 1988). *Given the variability of exposure to fluoride from infant formula and water used for mixing, caregivers of formula-fed infants should consult with their infants' health care provider for advice on fluoride.*

Considerations for Infants on Solid Foods Once a breastfed or formula-fed infant begins drinking fluoridated water or eating foods prepared with fluoridated water on a regular basis, the fluoride in the infant's diet will increase. Infants consuming primarily commercial baby food in jars, and water low in fluoride in infant formula, foods, or beverages, should be referred to a health care provider for advice on fluoride.

Estimated Range of Safe and Adequate Daily Dietary Intake of Fluoride

The estimated range of safe and adequate daily dietary intake of fluoride is 0.1 to 0.5 milligram during the first 6 months of life and 0.2 to 1.0 milligram during the second 6 months (NRC, 1989). The American Academy of Pediatrics recommends that infants receive a 0.25 milligram

fluoride supplement daily if their water supply contains less than 0.3 ppm (parts per million) of fluoride (CON, 1986; 1993).

Excessive Fluoride

Some infants and children may be drinking water that contains naturally occurring fluoride that exceeds the recommended levels for optimal dental health. To determine whether drinking water may contain excessive levels of fluoride, it should be tested as mentioned above. If a fluoride supplement is prescribed, it is important for the caregiver to give only the amount prescribed. These concerns are important because fluoride (from natural sources or supplements), when consumed in excess over time, may cause staining or "mottling" of the teeth, termed dental fluorosis. Mottling of the teeth has been observed in children consuming 2.0 to 8.0 parts per million (ppm) or milligrams per liter of fluoride in drinking water (NRC, 1971). An alternative water source is recommended when the home water supply contains 2.0 ppm or more of fluoride. The unintentional ingestion of toothpaste can cause an increase in daily dietary fluoride intake. For this reason, it is not recommended that toothpaste be used with infants. See also page 20 for information on fluoride in bottled water.

Sodium

Functions

Sodium, a mineral, is required to:

- Maintain the water balance in the body;
- Regulate blood volume; and
- Ensure the proper functioning of cell membranes and other body tissues.

Sources

Full-term infants consuming primarily human milk or infant formula of standard dilution would receive a relatively small amount of sodium but an amount adequate for growth. The sodium level in cow's milk is greater than that in human milk and most infant formulas. An infant's sodium intake increases when cow's milk, commercial "baby" foods designed for toddlers, and table foods are added to the diet. Manufacturers have stopped adding salt to all commercial strained and junior baby foods. However, salt is added to toddler "baby" foods, designed for children from 1 to 4 years old, to improve their taste; these foods are not recommended for infants. The amount of sodium consumed by an infant on table foods reflects the cooking methods used in the home and the eating habits and cultural food patterns of the infant's family.

Sodium in Infant Diets: Effect on Later Health

On the basis of animal studies conducted in the 1970's, it was suggested that the sodium content of the diets of infants in the United States may predispose them to hypertension in later life (Dahl et al., 1963; Dahl et al., 1968; Dahl, 1972; Meneely and Dahl, 1961). However, the only available prospective study conducted with human infants suggests that a high sodium intake during the first year of life did not lead to hypertension during infancy or later (Whitten and Stewart, 1980). It is also unclear whether infants fed high-salt diets before 1 year old develop a preference for salty foods that lasts into later life (CON, 1985). The American Academy of Pediatrics has indicated that infants do not need a high level of sodium in their diets, despite the lack of conclusive evidence that high-sodium intakes during infancy and childhood are detrimental to the health of children likely to develop hypertension as adults (CON, 1993). Thus, it is not necessary or recommended to add salt or salty foods (such as regular canned vegetables or soups, regular tomato juice (low-salt tomato juice is available), cured and processed meats, and salted crackers, pretzels, or snack foods) to an infant's diet.

Water

Functions

Water is required by infants because it:

- Is essential for regulating body temperature;
- Serves as a fluid medium that allows for the transport of nutrients and metabolic waste products;
- Is needed for cell metabolism; and
- Is important for normal kidney function.

An infant needs to replace the water lost through the skin, lungs, feces, and urine, and the small amount of water needed for growth (Fomon, 1974).

Water and Renal Solute Load of Foods

The role that water plays in the excretion of waste products by an infant's kidneys is particularly important. The kidney needs water to easily excrete waste products, called solutes, via the urine. Solutes are "end products" formed after food has been fully digested and metabolized. Examples of solutes include compounds containing nitrogen from the breakdown of protein, and the minerals sodium, potassium, and chloride that are consumed in excess of body needs. The term used to express the relative amount of solutes from a food or mixture of foods presented to the kidney for excretion is "renal solute load."

The higher the renal solute load of a food, the more water is required to properly excrete the byproducts that result from digestion and metabolism of the food. The immature kidneys in very young infants have difficulty handling the byproducts of foods with a high renal solute load. These foods include unmodified whole cow's milk and high protein foods (Fomon, 1974). Human milk has a lower renal solute load compared to commercial infant formulas and diluted evaporated whole-milk formulas; cow and goat's milk have a much higher renal solute load than commercial infant formulas. Due to their very high renal solute load, boiled undiluted cow's milk, undiluted evaporated milk, or highly concentrated infant formula should not be fed to infants. When milk is boiled, some of the water in it evaporates leading to an excessive concentration of protein and minerals. Low-fat, especially skim, cow's milk also has an excessive concentration of protein and minerals.

Sources and Meeting Water Needs

Infants consume water alone or as a component of food. Water is also formed in the body in chemical reactions occurring to metabolize protein, fats, and carbohydrates. Under normal circumstances, the water requirements of healthy infants, less than 6 months old who are fed adequate amounts of breast milk or properly diluted infant formula, are met by the breast milk or formula alone. However, infants in hot weather may require some extra water in the diet (see below). Also, infants who begin eating a variety of solid foods, and especially any foods containing protein, should be fed some water (about 4 to 8 ounces) each day, for the reasons described below. Under certain circumstances, additional water or special fluids are needed in the diet, as described below. If in doubt about how much water an infant should drink, consult with the infant's health care provider.

Insufficient Water Intake

Infants may receive an insufficient amount of water under any of the following circumstances (CON, 1985; Fomon, 1974; Grand et al., 1987; Howard and Winter, 1984):

Dietary Intake-Related Circumstances

- **Infant is fed formula which is too concentrated**—When too little water is added to concentrated or powdered formula, the renal solute load of the formula will be high. Instruct the caregiver on proper formula preparation and dilution to avoid this problem.
- **Infant consumes much less formula or breast milk than usual, such as when ill**—Infants who are ill and are not feeding normally should be referred to a health care provider.
- **Infant consumes protein-rich or salty foods with a high renal solute load**—These foods include protein-rich foods such as home-prepared meats, commercial baby food plain meats and meat dinners, egg yolks, and foods with added salt. Consumption of some water (about 4 to 8 ounces per day) is recommended if these foods are eaten. Note that fruit juices and plain fruits and vegetables have a low renal solute load.
- **Infant is fed skim or low-fat cow's milk**—These milks, with their high renal solute load, are not recommended and may be dangerous for infants.

Medical Condition-Related Circumstances (Water Requirements/Needs Are Increased)

- **Infant is vomiting or has diarrhea**—Refer infants with vomiting or diarrhea to a health care provider. Caregivers who attempt to

self-treat diarrhea by, for example, feeding their infants large amounts of water or other liquids (e.g., fruit juices, soda, diluted fruit punches, drinks, or aides, tea, broth, or gelatin water), instead of an appropriate oral electrolyte solution (which should be used under a physician's supervision), may actually worsen the condition. Those home-prepared beverages can cause fluid from the body to be drawn into the intestinal tract and thus encourage greater fluid loss from the body (Pemberton et al., 1988). See below for information on excessive water intake and page 122 for more information on oral electrolyte solutions.

- **Infant is having a fever**—Fever increases an infant's water requirements. Refer infants whose caregivers complain that they have fever to a health care provider.
- **Infant has a medical condition that increases water requirements (e.g., diabetes insipidus)**—Infants with medical conditions, such as diabetes insipidus, should be under a health care provider's care.

Climate-Related Circumstances (Living or Spending Time in a Hot Climate)

Infants in a hot climate lose water by perspiring. Formula-fed infants in a hot climate should be fed some water (about 4 to 8 ounces per day unless otherwise indicated by a health care provider) during the day. Research has shown that the water in breast milk alone can meet the water requirements of healthy **exclusively** breastfed infants in hot humid climates (Lawrence, 1989)—however, if in doubt, consult with the infant's health care provider for advice on feeding water to the **exclusively** breastfed infant in hot weather. If a breastfed infant starts consuming solid foods or some infant formula, or becomes ill, it may be appropriate to feed some water in hot or normal weather. In those cases, the infant's health care provider should be consulted for advice.

Dehydration

Since dehydration (excessive loss of water from the body) can lead to death in infants, caregivers need to be aware of the signs of dehydration which include the following:

- A reduced amount of urine which is also dark yellow in color;
- Dry membranes in the mouth;
- No tears when crying;
- Sunken eyes; and
- Restlessness, irritability, or lethargy.

Refer an infant to a health care provider for immediate medical attention if the caregiver notes that the infant has any of these symptoms. Lack of fluids in the diet can also lead to constipation in infants. See page 123 regarding constipation.

Excessive Water in the Diet and Water Intoxication

Water intoxication can occur if infants are fed excessive amounts of water. This condition can develop in infants who consume infant formula overdiluted with water and those who are force-fed water. This condition, while preventable, can be life-threatening to an infant. Symptoms of the condition include respiratory failure, seizures, and convulsions (Keating et al., 1991). Also, infants fed excessive water will not receive adequate kilocalories to meet needs for growth and development. One study found the occurrence of water intoxication highest among 3- to 6-month-old infants from low-income families; many of these infants were enrolled in the WIC Program (Keating et al., 1991). Caregivers of infants who developed water intoxication were found to have substituted water for infant formula because they ran out of formula or fed water for diarrhea, an infection, irritability, fussiness, or because the infant was "very thirsty" or it was a very hot day (Keating et al., 1991).

In summary, it is important to review the following with caregivers of fully or partially formula-fed infants:

- Correct formula preparation (including dilution) procedures (see pages 77-79 and figures 7a, 7b, and 7c, pages 80-82);
- Do not substitute a bottle of water or dilute beverages (fruit juice, sweetened beverages, tea, etc.) as a feeding in place of infant formula (or breast milk). Plain water and fruit juice are meant to be fed in relatively small amounts primarily as a source of fluid supplementing a nutritionally balanced diet.

Do not allow the infant to drink at will from a bottle of water or dilute liquid all day or for extended periods. Young infants need to be fed a sufficient amount of breast milk, infant formula, and/or appropriate solid foods to meet their kilocalorie and other nutrient needs;

- The circumstances in which plain water in the diet is recommended for the healthy infant (i.e., when solid foods are started, or in hot weather for formula-fed or partially breastfed infants) and the appropriate amount of water to feed per day (a total of about 4 to 8 ounces per day, unless otherwise indicated by a health care provider), and the critical importance of seeing a health care provider if an infant has diarrhea, fever, vomiting, or other illness and not self-treating the condition at home (see page 122). It is not recommended to routinely offer water to an infant after nursings or formula feedings;
- What to do if the caregiver runs out of infant formula. Since the WIC and CSF Programs' formula allowance is intended to be supplemental and not meet the nutritional needs of all infants, many caregivers will need to obtain additional formula beyond that provided by WIC or CSFP at some point. If the amount of infant formula provided by the WIC or CSF Program is insufficient to meet an infant's needs, then:
  - Offer powdered infant formula instead of concentrated or ready-to-feed infant formula, if the infant is on standard milk- or soy-based formula (the maximum monthly allowance of standard milk- or soy-based powdered infant formula yields approximately 30 to 32 fluid ounces per day compared to a yield of approximately 26 fluid ounces per day for standard concentrated liquid or ready-to-feed infant formula); and
  - Refer the caregiver to sources of financial assistance in the community which can help him or her purchase additional formula or services that provide the appropriate infant formula at low or no cost.

Safety of the Water Supply

Formula-fed infants, on concentrated or powdered infant formula, consume a significant quantity of water which is added in formula preparation. Thus, it is important that the water consumed be safe and free of potentially harmful contaminants. Water from public or municipal water systems is regularly tested for contaminants regulated by Federal and State standards, such as pathogens, radioactive elements, and certain toxic chemicals. However, some municipal or rural water supplies are not regularly tested due to lack of funds. Furthermore, there are a variety of routes through which contaminants can enter a home's or apartment's water supply; e.g., via lead pipes, lead solder, or lead service lines; bacteria inside the home's or building's plumbing system, or community water system; or a contaminated ground water supply draining into a household well.

Thus, anyone with an infant or child and all pregnant women should strongly consider having their water tested for potentially detrimental contaminants such as lead, copper, nitrates, and bacteria. If contaminants are found, appropriate actions (as described in the box, pages 20-23) can be taken to reduce the risk to infants and children. Refer to the box on pages 20-23 for more information on the safety of well water, lead, copper, and nitrate contamination, the use of bottled water, and home water treatment units.

For more information on health issues specific to drinking water contaminants (e.g., lead, nitrate, bacteria, pesticides), for consumer brochures on water safety, and for assistance in locating a State drinking water office or a State laboratory certification officer to obtain a list of approved water testing labs, contact the U.S. Environmental Protection Agency (EPA) Safe Drinking Water Hotline at 1-800-426-4791. The hotline operates from 9:00 a.m. to 5:30 p.m. EST.

Additional Information on Safety of the Water Supply

Well Water

Caregivers deriving water from a private household or community water system well who are unaware of the safety of their water should strongly consider having their water tested for bacteria, nitrates, and other contaminants. Private household wells are not regulated by the same Federal drinking water standards as a public water system. As a result, the burden is on the user to determine if the well water is safe to drink. Potential sources of contaminants of well water include the following:

- Any past and present uses in the area near the well, such as the application of lawn care or agricultural chemicals or improper disposal of household chemicals (e.g., used motor oil, paints and thinners, cleaning fluids);
- Nearby gas stations or factories;
- Septic tank systems; or
- Livestock management areas located close to the well.

Well water containing 2.0 to 8.0 ppm (parts per million) levels of fluoride may cause dental fluorosis (staining or mottling of the teeth) if infants or children drink it during tooth formation for an extended time. Thus, well water should be tested for fluoride. When water contains 2.0 ppm or more of fluoride, advice should be obtained from a medical or dental health care provider to determine if the exclusive use of bottled water, or the blending of home and bottled water, is recommended.

For information on testing well water, caregivers can contact the local health department or the State drinking water office (usually located in the State health department or environmental agency). For advice and information on possible contaminants in well water, contact the local health department, the State drinking water office, the nearest public water utility, or the Environmental Protection Agency's (EPA) Safe Drinking Water Hotline at 1-800-426-4791 between 9:00 a.m. and 5:30 p.m. EST.

Lead in Water

Lead levels are typically low in ground and surface water. Lead can enter drinking water following water treatment from plumbing materials that carry water to and within homes and residential buildings. Until the Federal Government banned the manufacture of lead plumbing materials in 1986 (EPA, 1989), pipes and solder containing lead were often used in water systems and homes.

Lead is a poison that can accumulate in the body and cause brain, nerve, and kidney damage, anemia, and even death. Lead is especially dangerous, even with short-term exposure, to infants, children, and pregnant women. While lead exposure through various sources (e.g., paint chips, toys, pottery) can occur, lead can be present in drinking water at sufficient levels to warrant concern. Lead levels in drinking water are likely to be highest if:

- A home or water system has lead pipes; or
- A home has copper pipes with lead solder and:
  - the home is relatively new (i.e., built shortly before the 1986 ban on lead in pipes—it takes time for mineral deposits to build up and cover up the lead inside pipes),
  - the home has soft water, or
  - water sits in the pipes for several hours.

Since one cannot see, taste, or smell lead dissolved in water, household drinking water must be tested to determine its lead content. The local water utility or local department of environment or health can provide information and assistance regarding testing and how to locate a laboratory qualified to test for lead. Testing is especially important because flushing (described below) may not be effective in reducing lead levels in high-rise buildings with lead-soldered central piping or in homes receiving water through lead service lines (the local water utility company can be contacted for information on the pipes carrying water into a home).

Unless a caregiver is certain that there is no lead contamination in his or her water, precautions can be taken against the possible leaching of lead from metal water pipes in the home. Caregivers can take these steps when using tap water to prepare powdered or concentrated infant formula or foods for their infants:

- Allow the cold tap water to run for a short period of time until it is as cold as it will get (about 2 minutes) before collecting it for formula or food preparation. This flushing is recommended for any faucet used to collect water for the infant. Flushing may help because the longer the water is exposed to lead pipes or lead solder, the more lead it may contain. As noted, flushing might not work in high-rise buildings or when lead service lines carry water into a home. Water for formula preparation can be collected in the evening after the water has been running for cooking or cleaning and stored in a clean lead-free container for use later or the next day (see pages 101-102 on lead and containers).
- Always draw water for formula preparation, drinking, and cooking from the cold water tap. Avoid feeding water from the hot water tap to infants or young children. Hot water is more likely to dissolve lead from plumbing materials and thus contain more lead. Infants have contracted lead poisoning from drinking infant formula made using hot tap water, which was then boiled (this concentrates the lead) (Shannon and Graef, 1992).
- If water is to be boiled, do so by bringing the water to a rolling boil and boiling for 5 minutes. Avoid prolonged boiling or reboiling; these practices will cause further water evaporation and concentration of any lead present. (See page 78 regarding boiling water.)
- If water treatment devices installed at the tap are used, be aware that their effectiveness in reducing lead in water varies and may be affected by the location of the device in relation to the lead source and by compliance with the manufacturer's use and maintenance instructions. Some types of units, such as reverse osmosis and distillation, may be effective. Carbon, sand, and cartridge filters do not remove lead.
- Have their water tested for lead because lead can come from pipes inside or outside a home or apartment or from a well.

If caregivers are concerned about the lead level in water or if lead contamination is found through testing, encourage them to discuss this issue with their health care provider. The health care provider might recommend using distilled bottled water to mix with infant formula powder or concentrate, or recommend using ready-to-feed infant formula which does not require mixing with water. Recommendations of the infant's health care provider on boiling of distilled water should be followed.

Copper in Water

High levels of copper can dissolve from some pipes in areas with corrosive water. Copper, which is beneficial at lower levels, is a health risk at levels above 1.3 milligrams per liter in water. Acute exposure to copper has resulted in gastrointestinal effects, such as nausea and diarrhea. When water is tested, it can be tested for copper. If high levels of copper are found, a health care provider should be contacted for advice.

Nitrate in Water

Drinking water from private household or community water system wells may become contaminated from nitrate derived from agricultural and home lawn and garden uses of nitrate fertilizers, septic tank wastes, and sewage sludge. Nitrate in drinking water above the national standard (10 milligrams nitrate per liter (L)) poses an immediate threat to infants. In some infants, exposure to high levels of nitrate through well water may result in methemoglobinemia, also known as blue baby syndrome, in which the blood's ability to carry oxygen is reduced (CON, 1970; Comly, 1945). This condition could result in a severe oxygen deficiency and could lead to death. Methemoglobinemia related to drinking water contaminated with nitrate has only been observed in infants, especially those with gastrointestinal disorders, up to the age of 3 to 6 months (EPA, 1990).

It is recommended that caregivers with private household wells have their water tested for nitrate, especially if agricultural activities including home gardening occur in the area or if animal and human wastes are suspected of entering the well. Users of water from community water system wells who suspect that their water is contaminated can contact their State public water supply agency regarding contaminant levels in the water. If the nitrate level in well water is confirmed to be above 10 mg/L, it is recommended that caregivers:

- Consult their health care providers about this problem; and
- Feed their infants only water from an alternate source that has less than 10 mg/L of nitrate and avoid feeding their infants the nitrate-rich water plain or in formula, especially if boiled (boiling

concentrates the nitrate). Ready-to-feed formula can be used as an alternative to formula that requires dilution with water.

Use of Bottled Water

Bottled water is an alternative for use in preparing formula and foods for infants if the local water supply exceeds health-based drinking water standards, if naturally occurring fluoride exceeds the recommended levels, or if corrosion of household plumbing causes lead and/or copper to enter the drinking water. If bottled water is to be used, distilled bottled water may be the best choice as it may contain fewer contaminants than bottled spring or mineral water. To help decide whether to use bottled water, caregivers can contact a health care provider and the local or State health department for information on local water quality problems and recommendations.

Although the Food and Drug Administration (FDA) requires that bottled water products be clean and safe for human consumption, the General Accounting Office (GAO) has indicated that the FDA's oversight of bottled water does not ensure that it meets existing Federal regulations and standards regarding water safety (GAO, 1991). GAO asserted that due to inadequate regulation, bottled water, including mineral water, may contain levels of potentially harmful contaminants that are not allowed in public drinking water. One study of 37 brands of bottled mineral water found that 24 contained one or more substances that were not in compliance with Federal drinking water standards (Allen et al., 1989). Also, bottled waters contain varying levels of fluoride, which will affect the fluoride amount an infant receives. Thus, caregivers who wish to feed their infants a specific brand of bottled spring or mineral water should consider contacting the producer of the water product for information on the quality of their water.

Home Water Treatment Units

Home water treatment units can potentially remedy a water contamination problem. However, it is important to keep in mind that no single household treatment unit will remove all potential drinking water contaminants. Treatment is very specific to the substances of concern. Before selecting a unit, the water should be tested to confirm the nature and extent of contamination. After identifying the substances to be removed, a unit can be selected. Two reliable sources of information on treatment units include:

NSF International
P.O. Box 130140
Ann Arbor, MI 48113-0140
(313) 769-8010

The Water Quality Association
Consumer Affairs Department
P.O. Box 606
Lisle, IL 60532
(708) 505-0160

References:

- EPA (Environmental Protection Agency): **Drinking Water From Household Wells.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, September 1990; EPA 570/9-90-013.
- EPA (Environmental Protection Agency): **The Lead Ban: Preventing the Use of Lead in Public Water Systems and Plumbing Used for Drinking Water.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, August 1989; EPA 570/9-89-BBB.
- EPA (Environmental Protection Agency): **Citizen Monitoring: Recommendations to Public Water System Users.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, April 1990; EPA 570/9-90-005.
- EPA (Environmental Protection Agency): **Citizen Monitoring: Recommendations to Household Well Users.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, April 1990; EPA 570/9-90-006.
- EPA (Environmental Protection Agency): **Lead and Your Drinking Water.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, April 1987; OPA-87-006.
- CDC (Centers for Disease Control): **Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control.** Atlanta: CDC, 1991.
- Infant Formula Council: Stand-by statement of the Infant Formula Council regarding the potential for lead ingestion from water used to prepare infant formula. January 8, 1992.
- Shannon, M.W. and Graef, J.W. Lead intoxication in infancy. **Pediatrics** 89(1):87-90, 1992.
- Personal communication with Ronald E. Kleinman, M.D., Chairman, Committee on Nutrition, American Academy of Pediatrics, regarding lead in water, 1992.
- Personal communication with Tom Matte, M.D., Medical Epidemiologist, Centers for Disease Control, regarding lead in water, 1992.
- EPA (Environmental Protection Agency): **National Pesticide Survey: Nitrate.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, Office of Pesticides and Toxic Substances, Fall 1990.
- EPA (Environmental Protection Agency): **Bottled Water: Helpful Facts and Information.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, September 1990; EPA 570-90-GGG.
- GAO (General Accounting Office): **Stronger FDA Standards and Oversight Needed for Bottled Water. Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.** Washington, DC: U.S. General Accounting Office, 1991.
- Allen, H.E., Halley-Henderson, M.A., and Hass, C.N. Chemical composition of bottled mineral water. **Arch. Environ. Health** 44: 102-116, 1989.
- EPA (Environmental Protection Agency): **Home Water Filtration Units: Filtering Fact from Fiction.** Washington, DC: U.S. Environmental Protection Agency, Office of Water (WH-550A), September 1990; EPA 570/9-90-HHH.

References

Allen, H.E., Halley-Henderson, M.A., and Hass, C.N. Chemical composition of bottled mineral water. **Arch. Environ. Health** 44: 102-116, 1989.

Bachrach, S., Fisher, J., and Parks, J.S. An outbreak of vitamin D deficiency rickets in a susceptible population. **Pediatrics** 64: 871-877, 1979.

Bergan, J.G. and Brown P.T. Nutritional status of "new" vegetarians. **J. Am. Diet Assoc.** 76: 151-155, 1980.

Bothwell, T.H., Charlton, R.W., Cook, J.D., and Finch, C.A. **Iron Metabolism in Man.** Oxford, England: Blackwell, 1979.

CDA and SSDA (Chicago Dietetic Association and the South Suburban Dietetic Association). **The Manual of Clinical Dietetics.** Chicago, IL: The American Dietetic Association, 1992.

Chase, H.P., Kumar, V., Caldwell, R.T., and O'Brien, D. Kwashiorkor in the United States. **Pediatrics** 66: 972-976, 1980.

Clemens, T.L., Adams, J.S., Henderson, S.L., and Holick, M.F. Increased skin pigment reduces capacity of skin to synthesize vitamin D_3. **Lancet** 1: 74-76, 1982.

Close, G.C. Rastafarianism and the vegans syndrome. **Br. Med. J.** 286: 473, 1983.

Comly, H.H. Cyanosis in infants caused by nitrates in well water. **J.A.M.A.** 129: 112, 1945.

CON (Committee on Nutrition), American Academy of Pediatrics. Infant methemoglobinemia: The role of dietary nitrate. **Pediatrics** 46: 475-477, 1970.

_____. Commentary on breast-feeding and infant formulas, including proposed standards for infant formulas. **Pediatrics** 57: 278, 1976.

_____. Plant fiber intake in the pediatric diet. **Pediatrics** 67: 572-575, 1981.

_____. Toward a prudent diet for children. **Pediatrics** 71: 78, 1983.

_____. **Pediatric Nutrition Handbook**. 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1985.

_____. Fluoride supplementation. **Pediatrics** 77: 758, 1986a.

_____. Prudent life-style for children: dietary fat and cholesterol. **Pediatrics** 78: 521-25, 1986b.

_____. Iron-fortified infant formulas. **Pediatrics** 84: 1114-1115, 1989.

_____. The use of fruit juice in the diets of young children. **AAP News** 7: 11, 1991.

_____. The use of whole cow's milk in infancy. **Pediatrics** 89: 1105-1109, 1992a.

_____. Statement on cholesterol. **Pediatrics** 90: 469-473, 1992b.

_____. **Pediatric Nutrition Handbook.** 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1993.

Consensus conference. Lowering blood cholesterol to prevent heart disease. **JAMA** 253: 2080-86, 1985.

Dahl, L.K. Salt and hypertension. **Am. J. Clin. Nutr.** 25: 231, 1972.

Dahl, L.K., Heine, M., and Tassinari, L. High salt content of western infant's diet: Possible relationship to hypertension in the adult. **Nature** 198: 1204-1205, 1963.

Dahl, L.K., Knudsen, K.D., Heine, M.A., and Leitl, G.J. Effects of chronic excess salt ingestion: Modification of experimental hypertension in the rat by variations in the diet. **Circ. Res.** 22: 11, 1968.

Dallman, P.R., Siimes, M.A., and Stekel, A. Iron deficiency in infancy and childhood. **Am. J. Clin. Nutr.** 33: 86-118, 1980.

Davis, J.R., Jr., Goldenring, J., and Lubin, B.H. Nutritional vitamin B_{12} deficiency in infants. **Am. J. Dis. Child.** 135: 566-567, 1981.

DHHS (U.S. Department of Health and Human Services), Public Health Service, Health Services Administration, Bureau of Community Health Services: **Nutritional Screening of Children: A Manual for Screening and Follow-up.** Washington, DC: U.S. Government Printing Office, 1981.

Dobbing, J.: **Brain, Behavior and Iron in the Infant Diet.** New York: Springer-Verlag, 1990.

Duncan, B., Schifman, R.B., Corrigan, J.J., Jr., and Schaefer, C. Iron and the exclusively breast-fed infant from birth to six months. **Journal of Pediatric Gastroenterology and Nutrition** 4: 421-425, 1985.

Edidin, D.V., Levitsky, L.L., Schey, W., Dumbovic, N., and Campos, A. Resurgence of nutritional rickets associated with breastfeeding and special dietary practices. **Pediatrics** 65: 232-235, 1980.

EPA (Environmental Protection Agency): **The Lead Ban: Preventing the Use of Lead in Public Water Systems and Plumbing Used for Drinking Water.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, EPA 570/9-89-BBB, 1989.

EPA (Environmental Protection Agency): **National Pesticide Survey: Nitrate.** Washington, DC: U.S. Environmental Protection Agency, Office of Water, Office of Pesticides and Toxic Substances, 1990.

FAO (Food and Agriculture Organization). **Requirements of Vitamin A, Iron, Folate, and Vitamin B_{12}. Report of a Joint FAO/WHO Expert Consultation.** FAO Food and Nutrition Series No. 23. Food and Agriculture Organization, Rome, 1988.

Fomon, S.J.: **Infant Nutrition.** Philadelphia, PA: W.B. Saunders Company, 1974.

Fomon, S.J., Rogers, R.R., Ziegler, E.E., Nelson, S.E., and Thomas, L.N. Indices of fatness and serum cholesterol at age eight years in relation to feeding and growth during early infancy. **Pediatr. Res.** 18: 1233-1238, 1984.

Friedman, G. and Goldberg, S.J. Concurrent and subsequent serum cholesterols of breast- and formula-fed infants. **Am. J. Clin. Nutr.** 28: 42-45, 1975.

Full, C.A. and Parkins, F.M. Effect of cooking vessel composition on fluoride. **J. Dent. Res.** 54: 192, 1975.

Gambon, R.C., Lentze, M. J., and Rossi, E. Megaloblastic anaemia in one of monozygous twins breast fed by their vegetarian mother. **Eur. J. Pediatr.** 145: 570-571, 1986.

Garry, P.J., Owen, G.M., Hooper, E.M., and Gilbert, B.A. Iron absorption from human milk and formula with and without iron supplementation. **Pediatr. Res.** 15: 822-828, 1981.

GAO (General Accounting Office). **Stronger FDA Standards and Oversight Needed for Bottled Water. Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.** Washington, DC: U.S. General Accounting Office, 1991.

Grand, R.J., Sutphen, J.L., and Dietz, W.H. **Pediatric Nutrition: Theory and Practice.** Boston, MA: Butterworth Publishers, 1987.

Greene, H.L. and Ghishan, F.K. Excessive fluid intake as a cause of chronic diarrhea in young children. **J. Pediatr.** 102: 836-840, 1983.

Hamosh, M. Does infant nutrition affect adiposity and cholesterol levels in the adult? **J. Pediatr. Gastroenterol. Nutr.** 7: 10-16, 1988.

Hayward, I., Stein, M.T., and Gibson, M.I. Nutritional rickets in San Diego. **Am. J. Dis. Child.** 141: 1060-1062, 1987.

Higginbottom, M.C., Sweetman, L., and Baker, S.J.: A syndrome of methylmalonic aciduria, homocystinuria, megaloblastic anemia and neurologic abnormalities in a vitamin B_{12}-deficient breast-fed infant of a strict vegetarian. **N. Engl. J. Med.** 299: 317-323, 1978.

Hodgson, P.A., Ellefson, R.D., Elveback, L.R., Harris, L.E., Nelson, R.A., and Weidman, W.H. Comparison of serum cholesterol in children fed high, moderate, or low cholesterol milk diets during neonatal period. **Metabolism** 25: 739-746, 1976.

Howard, R.B. and Winter, H.S.: **Nutrition and Feeding of Infants and Toddlers.** Boston, MA: Little, Brown and Company, 1984.

Huttunen, J.K., Saarinen, U.M., Kostiainen, E., and Siimes, M.A. Fat composition of the infant diet does not influence subsequent serum lipid levels in man. **Atherosclerosis** 46: 87-94, 1983.

IOM (Institute of Medicine). **Nutrition During Lactation. Report of the Subcommittee on Nutrition During Lactation, Food and Nutrition Board, Institute of Medicine.** Washington, DC: National Academy Press, 1991.

Jelliffe, D.B. Unique Properties of Human Milk. **J. Reprod. Med.** 14: 133, 1975.

John, T.J., Blazovich, J., Lightner, E.S., Sieber, O.F., Corrigan, J.J., and Hansen, R. Kwashiorkor not associated with poverty. **J. Pediatr.** 90: 730-735, 1977.

Keating, J.P., Schears, G.J., and Dodge, P.R. Oral water intoxication in infants: an American epidemic. **AJDC** 145: 985-990, 1991.

Kwiterovich, P. Biochemical, clinical, epidemiologic, genetic, and pathologic data in the pediatric age group relevant to the cholesterol hypothesis. **Pediatrics** 78: 348-362, 1986.

Lawrence, R.A. **Breastfeeding: A Guide for the Medical Profession.** 3rd ed. St. Louis, MO: The C.V. Mosby Company, 1989.

Lönnerdal, B., Keen, C.L., and Hurley, L.S. Iron, copper, zinc, and manganese in milk. **Annu. Rev. Nutr.** 1: 149-174, 1981.

Lönnerdal, B., Keen, C.L., and Hurley, L.S. Zinc binding ligands and complexes in zinc metabolism. **Adv. Nutr. Res.** 6: 139-167, 1984.

Lozoff, B., Brittenham, G.M., Wolf, A.W., et al. Iron deficiency anemia and iron therapy effects on infant development test performance. **Pediatrics** 79: 981-985, 1987.

Mahaffey, K.R. Nutritional factors in lead poisoning. **Nutr. Rev.** 39: 353-362, 1981.

Mahaffey, K.R. and Michaelson, I.A. The interaction between lead and nutrition. In: Needleman, H.L., editor. **Low Lead Exposure: the Clinical Implications of Current Research.** New York, NY: Raven Press, 1980.

Marier, J.R. and Rose, D. The fluoride content of some food and beverages—a brief survey using a modified Zr-SPANDNS method. **J. Food Sci.** 31: 941-946, 1966.

Marmot, M.G., Page, C.M., Atkins, E., and Douglas, J.W.B. Effect of breastfeeding on plasma cholesterol and weight in young adults. **J. Epidemiol. Commun. Health** 34: 164-167, 1980.

Martin, D.J. The Evanston Dental Caries Study. VIII. Fluorine content of vegetables cooked in fluorine containing waters. **J. Dent. Res.** 30: 676-681, 1951.

Meneely, G.R., and Dahl, L.K. Electrolytes in hypertension: the effects of sodium chloride. The evidence from animal and human studies. **Med. Clin. N. Amer.** 45: 271, 1961.

Mott, G.E., Jackson, E.M., McMahan, C.A., and McGill, H.C., Jr. Cholesterol metabolism in adult baboons is influenced by infant diet. **J. Nutr.** 120: 243-251, 1990.

NCEP (National Cholesterol Education Program). **Report of the Expert Panel on Population Strategies for Blood Cholesterol Reduction.** Bethesda, MD; U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Heart, Lung, and Blood Institute, November 1990; NIH Pub. No. 90-3046.

NCEP (National Cholesterol Education Program). **Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents.** Bethesda, MD; U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Heart, Lung, and Blood Institute, September 1991; NIH Pub. No. 91-2732.

NRC (National Research Council). **Fluorides, Report of the Committee on Biologic Effects of Atmospheric Pollutants.** Washington, DC: National Academy of Sciences, 1971.

NRC (National Research Council). **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs,** Food and Nutrition Board, Commission on Life Sciences. Washington, DC: National Academy Press, 1989.

Nelson, S.E., Ziegler, E.E., Copeland, A.M., et al. Lack of adverse reactions to iron-fortified formula. **Pediatrics** 81: 360-364, 1988.

Oski, F.A. Iron-fortified formulas and gastrointestinal symptoms in infants: A controlled study. **Pediatrics** 66: 168-170, 1980.

Oski, F.A. and Landaw, S.A. Inhibition of iron absorption from human milk by baby food. **Am. J. Dis. Child.** 134: 459-460, 1980.

Owen, G.M., Garry, P.J., Hooper,. E.M., Gilbert, B.A., and Pathak, D. Iron nutriture of infants exclusively breast-fed the first five months. **J. Pediatr.** 99: 237-240, 1981.

Partridge, et al. Water intoxication secondary to feeding mismanagement. **Am. J. Dis. Child.** 135: 38, 1981.

Pemberton, C.M., Moxness, K.E., German, M.J., Nelson, J.K., and Gastineau, C.F. **Mayo Clinic Diet Manual: A Handbook of Dietary Practices.** 6th ed. Philadelphia, PA: B.C. Decker, Inc., 1988.

Picciano, M.F. and Deering, R.H. The influence of feeding regimens on iron status during infancy. **Am. J. Clin. Nutr.** 33: 746-753, 1980.

Pipes, P.L.: **Nutrition in Infancy and Childhood.** St. Louis, MO: Times Mirror/Mosby College Publishing, 1989.

Pollitt, E., Hathirat, P., Kotchabhakdi, N., et al. Iron deficiency and educational achievement in Thai children, abstracted. **FASEB** 2: A11196, 1988.

Reiser, R. and Sidelman, Z. Control of serum cholesterol homeostasis by cholesterol in the milk of the suckling rat. **J. Nutr.** 102: 1009-1016, 1972.

Reiser, R., O'Brien, B.C., Henderson, G.R., and Moore, R.W. Studies on a possible function for cholesterol in milk. **Nutr. Rep. Int.** 19: 835-849, 1979.

Rendle-Short, J., Tiernan, J.R., and Hawgood, S. Vegan mothers with vitamin B_{12} deficiency. **Med. J. Aust.** 2: 483, 1979.

Robinson, C.H., Lawler, M.R., Chenoweth, W.L., and Garwick, A.E.: **Normal and Therapeutic Nutrition.** New York, NY: Macmillan Publishing Company, 1986.

Saarinen, U.M. and Siimes, M.A. Iron absorption from breast milk, cow's milk, and iron-supplemented formula: an opportunistic use of changes in total body iron determined by hemoglobin, ferritin, and body weight in 132 infants. **Pediatr. Res.** 13: 143-147, 1979.

Saarinen, U.M., Siimes, M.A., and Dallman, P.R. Iron absorption in infants: high bioavailability of breast milk iron as indicated by the extrinsic tag method of iron absorption and by the concentration of serum ferritin. J. **Pediatr.** 91: 36-39, 1985.

Shannon, M.W. and Graef, J.W. Lead intoxication in infancy. **Pediatrics** 89: 87-90, 1992.

Shils, M.E. and Young, V.R. **Modern Nutrition in Health and Disease.** 7th ed. Philadelphia, PA: Lea and Febiger, 1988.

Silverman, A. and Roy, C.C. Diarrheal disorders: allergic diarrhea. In: Silverman, A. and Roy, C.C., eds. **Pediatric Clinical Gastroenterology**. 3rd ed. St. Louis, MO: C.V. Mosby Co., 1983.

Singer, L. and Ophaug, R. Total fluoride intake of infants. **Pediatrics** 63: 460-464, 1979.

Sklar, R. Nutritional vitamin B_{12} deficiency in a breast-fed infant of a vegan-diet mother. **Clin. Pediatr.** 25: 219-221, 1986.

Specker, B.L., Valanis, B., Hertzberg, V., Edwards, N., and Tsang, R.C. Sunshine exposure and serum 25-hydroxyvitamin D concentrations in exclusively breast-fed infants. **J. Pediatr.** 107: 372-376, 1985.

Specker, B.L., Miller, D., Norman, E.J., Green, H., and Hayes, K.C. Increased urinary methylmalonic acid excretion in breast-fed infants of vegetarian mothers and identification of an acceptable dietary source of Vitamin B_{12}. **Am. J. Clin. Nutr.** 47: 89-92, 1988.

US DHEW (Department of Health, Education, and Welfare), Division of Dental Health. **Natural Fluoride Content of Community Water Supplies.** Bethesda, MD: US Department of Health, Education, and Welfare, 1969.

Van Duzen, J., Carter, J.P., Secondi, J., et al. Protein and calorie malnutrition among preschool Navajo Indian children. Am. **J. Clin. Nutr.** 22: 1362, 1969.

Walker, W.A. and Hendricks, K.M. **Manual of Pediatric Nutrition.** Philadelphia, PA: W.B. Saunders Company, 1985.

Walter, R., De Andraca, I., Chadud, P., et al. Adverse effect of iron deficiency anemia on infant psychomotor development. **Pediatr. Res.** 23: 650, 1988.

Walton, J.L. and Messer, L.B. Dental caries and fluorosis in breast-fed and bottle-fed children. **Caries Res.** 15: 124-137, 1981.

Weidman, W., Kwiterovich, P., Jr., Jesse, M.J., and Nugent, E. Diet in the healthy child. Task Force Committee of the Nutrition Committee and the Cardiovascular Disease in the Young Council of the American Heart Association. **Circulation** 67: 1411A-14A, 1983.

Whitten, C.F. and Stewart, R.A. The effect of dietary sodium in infancy on blood pressure and related factors. Studies of infants fed salted and unsalted diets for five months at eight months and eight years of age. **Acta Paediat. Scand.** 279 [Supp.]: 3, 1980.

Woodruff, C.W., Latham, C., and McDavid, S. Iron nutrition in the breast-fed infant. **J. Pediatr.** 90: 36-38, 1977.

Development of an Infant's Feeding Skills

An infant's developmental readiness determines the type and texture of foods to feed and which feeding styles to use. All infants develop at their own rate. Although age and size often correspond with developmental readiness, these should not be used as the only factors considered when deciding what and how to feed infants. The rate at which an infant progresses to each new food texture and feeding style is determined by the infant's own skills and attitudes. Some infants are cautious, others venturesome. Infants always do better if they are allowed to develop at their own rate. It is important to be aware of the stages of mouth, hand, and body skill development in infants so that you can provide appropriate nutrition counseling on food types, texture, and feeding methods to caregivers.

Stages of Mouth, Hand, and Body Skill Development in Infants

Figure 1—Sequence of Infant Development and Feeding Skills in Normal, Healthy Full-Term Infants, page 31, summarizes the development of an infant's mouth, hand, and body skills and how these affect the infant's ability to eat foods of different types and textures. This figure provides the background to understand why certain types and textures of food can generally be introduced during certain age periods, as shown in figure 9: Guidelines for Feeding Normal Infants, Birth to 1 Year Old, pages 108-109.

The ability of newborn infants to only suck and swallow liquids is due to their limited level of development. As infants mature, they learn how to eat strained solid foods from a spoon and eventually how to feed themselves small chunks of soft, cooked foods by hand and later by spoon. As shown in figure 1, there is an overlap of ages to allow for differences in development.

Several major reflexes related to feeding are evident during early infancy. These reflexes are defined as follows:

- **Rooting reflex**—When an infant's oral area (corners of the mouth, upper and lower lip, cheek, and chin) is touched by an object, the head and mouth turn in the direction of the object and the infant opens his or her mouth. This reflex allows the infant to seek out and grasp a nipple. This reflex is seen from birth to about 4 months (Morris and Klein, 1987).
- **Suck/swallow reflex**—After opening the mouth, when an infant's lips and mouth area are touched, suckling or sucking movements begin. As liquid moves into the mouth, the tongue immediately moves it to the back of the mouth for swallowing. This reflex facilitates feeding from the breast or bottle but not from a spoon or cup. This reflex is seen from birth to about 4 months (Morris and Klein, 1987).
- **Tongue thrust reflex**—When the lips are touched, the infant's tongue extends out of the mouth. This reflex allows for feeding from the breast or bottle but not from a spoon or cup. This reflex is seen from birth to about 4 to 6 months.
- **Gag reflex**—The infant gags when any object, such as a spoon or a piece of solid food, is placed way back in the mouth; the object is then propelled forward on the tongue. This reflex helps to protect an infant from swallowing inappropriate food or objects which could cause choking. This reflex is one reason for delaying solid foods, and the use of a spoon, until 4 to 6 months. This reflex diminishes by 4 months, but is retained to some extent in adults (Morris and Klein, 1987).

Note that infants with developmental disabilities may retain these reflexes for longer than normally expected or the reflexes may be stronger or weaker than normal. Refer infants who appear to have feeding problems or abnormal feeding reflexes to a health care provider for assessment, consultation, and referral, if needed, to specialists skilled in feeding assessment and treatment.

The Feeding Relationship

The interactions and communication between a caregiver and infant during feeding influence the infant's ability to progress in feeding skills and consume a nutritionally adequate diet. These interactions comprise "the feeding relationship," defined as "the complex of interactions that take place between the parent and child as they engage in food selection, ingestion, and regula-

tion behaviors" (Satter, 1986a). This relationship is nurtured when the caregiver correctly interprets the infant's feeding cues, is attentive to the infant's needs, and responds appropriately to satisfy those needs. When the feeding relationship is positive (the caregiver is sensitive and responsive to an infant's feeding cues) and the infant is fed a nutritionally balanced diet, the infant's health and nutritional status is promoted.

A dysfunctional feeding relationship can result in poor dietary intake and impaired growth (Ainsworth and Bell, 1969; Satter, 1986a; 1990a). Such a negative relationship is characterized by a caregiver consistently misinterpreting, ignoring, or overruling the infant's feeding cues, e.g., when a caregiver regularly forces an infant to consume additional food after he or she has become full and satisfied (Satter, 1986a). Infants, whose feeding cues are not eliciting the expected response from their caregiver, tend to become dissatisfied, confused about their sensations of hunger and satiety, and may become unusually passive (Satter, 1986a).

To develop positive feeding relationships between caregivers and their infants, encourage caregivers to (Satter, 1984; 1986a):

- Observe and be sensitive to their infants' hunger, satiety, and food preferences, and act promptly and appropriately to meet their feeding needs (see pages 47, 75, 104 for hunger cues, and pages 49, 75, 104 for satiety cues). Also, it is best to avoid putting the infant on a rigid feeding schedule. An older infant can be offered food at around the time when he or she usually eats but, in general, the caregiver should watch for the infant to indicate hunger. However, feeding at specific intervals of time may be necessary if an infant has certain medical conditions or is a sleepy infant who needs to be awakened to feed;
- Remember their infants' developmental capabilities and nutritional needs when deciding the type, amount, and texture of food and the method of feeding (i.e., use a spoon for feeding; allow for self-feeding with fingers); see figure 1 for guidelines for normal full-term infants;
- Offer food in a positive and accepting fashion without forcing or enticing the infant to eat. Avoid withholding food. Infants are biologically capable of regulating their own food intake to meet their needs for growth and may vary in the amount and types of foods eaten each day; and
- Calm the infant before and during eating to reinforce the infant's view that eating is a positive, pleasant, and anxiety-free experience.

In addition, caregivers can help their infants have positive feeding experiences and learn new eating skills by making the feeding environment relaxed and calm in these ways:

- Finding a comfortable place in their home for feeding and acting calm and relaxed during feeding;
- Having patience and taking time to communicate with and learn about their infants during feeding; and
- Showing their infants lots of love, attention, and cuddling in addition to feeding—reassure them that doing so will decrease fussiness and will not "spoil" the infant.

In some instances, social and financial problems within a household may cause anxiety with detrimental effects on the interaction and feeding relationship between mother and infant— this can lead to failure to thrive in an infant. If you perceive that a caregiver is not recognizing an infant's feeding cues, responds to them inappropriately, or cannot feed the infant properly, the infant and caregiver can be referred to:

- A health care provider for advice;
- Resources offering help with parenting skills;
- A specialist or other services for psychosocial evaluation; and
- The Early Periodic Screening, Diagnosis, and Treatment Program (EPSDT) for additional assessment, counseling, and followup services.

See Satter's work (Satter, 1990a; 1990b; 1987; 1986a; 1986b; 1984) for more information on the feeding relationship. Also, see the Selected Bibliography, pages 173-176 for references on parenting skills.

Figure 1

Sequence of Infant Development and Feeding Skills in Normal, Healthy Full-Term Infants*

Baby's Approximate Age	Developmental Skills		
	Mouth Patterns	Hand and Body Skills	Feeding Skills or Abilities Infant Can:
Birth through 5 months 	• Suck/swallow reflex • Tongue thrust reflex • Rooting reflex • Gag reflex	• Poor control of head, neck, trunk • Brings hands to mouth around 3 months	• Swallow liquids but pushes most solid objects from the mouth
4 months through 6 months 	• Drows in upper or lower lip as spoon is removed from mouth • Up-and-down munching movement • Can transfer food from front to back of tongue to swallow • Tongue thrust and rooting reflexes begin to disappear • Gag reflex diminishes • Opens mouth when sees spoon approaching	• Sits with support • Good head control • Uses whole hand to grasp objects (palmer grasp)	• Take in a spoonful of pureed or strained food and swollow it without choking • Drink small amounts from cup when held by another person, with spilling
5 months through 9 months 	• Begins to control the position of food in the mouth • Up-ond-down munching movement • Positions food between jaws for chewing	• Begins to sit alone unsupported • Follows food with eyes • Begins to use thumb and index finger to pick up objects (pincer grasp)	• Begin to eat mashed foods • Eat from a spoon easily • Hold a bottle independently with one or both hands • Drink from a cup with some spilling • Begin to feed self with hands
8 months through 11 months 	• Moves food from side-to-side in mouth • Begins to curve lips around rim of cup • Begins to chew in rotary pattern (diogonol movement of the jaw as food is moved to the side or center of the mouth)	• Sits alone easily • Transfers objects from hond to mouth	• Begin to eat ground or finely chopped food and small pieces of soft food • Begin to experiment with spoon but prefers to feed self with hands • Drink from a cup with less spilling
10 months through 12 months 	• Rotory chewing (diagonol movement of the jaw os food is moved to the side or center of the mouth)	• Begins to put spoon in mouth • Begins to hold cup • Good eye-hand-mouth coordinotion	• Eot chopped food and small pieces of soft, cooked toble food • Begin self-spoon feeding with help

*Developmentol stoges ore approximate and moy vory with individual infants.

See poge 32 for references for this figure.

References

Ainsworth, M.D.S. and Bell, S.M. Some contemporary patterns of mother-infant interaction in the feeding situation. In: Ambrose, A. (ed). **Stimulation in Early Infancy.** New York, NY: Academic Press Inc., 1969.

*Morris, S.E. and Klein, M.D. **Pre-Feeding Skills: A Comprehensive Resource for Feeding Development.** Tucson, AZ: Therapy Skill Builders, 1987.

*Pipes, P.L. and Trahms, C.M. **Nutrition In Infancy and Childhood.** St. Louis, MO: Mosby --Year Book, Inc., 1993.

*Satter, E. Feeding guidelines: Developmental guidelines for feeding infants and young children. **Food and Nutrition** News 56: 21-26, 1984.

Satter, E. The feeding relationship. **J. Am. Diet. Assoc.** 86: 352-356, 1986a.

*Satter, E. **Child of Mine: Feeding with Love and Good Sense.** Palo Alto, CA: Bull Publishing Co., 1986b.

*Satter, E. **How to Get Your Kid to Eat—But Not Too Much.** Palo Alto, CA: Bull Publishing Co., 1987.

Satter, E. Childhood feeding problems. **Feelings and Their Medical Significance.** vol. 32, no 2. Columbus, OH: Ross Laboratories, 1990a.

Satter, E. The feeding relationship: Problems and interventions. **J. Pediatr.** 117 (suppl): S181-S189, 1990b.

*Also references for figure 1, page 31.

Breastfeeding

Breast milk is the optimal food for infants. It is the only food an infant needs during the first 4 to 6 months of life, and it continues to be an important source of nutrients for the first year. Breastfeeding helps to establish a secure and loving relationship between the mother and her infant, and offers many other positive benefits. For these reasons and those below, breastfeeding should be actively promoted and supported as the most desirable method of infant feeding.

Benefits of Breastfeeding

For the infant, breast milk or breastfeeding:

- Provides antibodies and a variety of antimicrobial agents (Goldman and Goldblum, 1989), anti-inflammatory agents (Goldman et al., 1986; 1990) and immunologic stimulating agents (Goldman and Goldblum, 1989; 1990) which protect the infant from infection. Antibodies from the mother are of particular importance because the part of the infant's immune system that secretes antibodies does not mature for several months after birth (Burgio et al., 1980; Hanson et al., 1983);
- Provides the right balance of nutrients to support the infant's growth and development. These nutrients are provided in a form that is easier to absorb than those in infant formula. Breast milk composition changes over time to meet the infant's changing nutritional needs. Breast milk is designed to perfectly meet the needs of the human infant;
- Is sanitary and at the right temperature all the time;
- Provides skin-to-skin contact that is important for making the infant feel secure and loved;
- Appears to reduce the risk of developing gastrointestinal diseases (Cunningham, 1981 and 1991; Cushing and Anderson, 1982; Howie, 1990; Palti et al., 1984; Myers et al., 1984) and otitis media (ear infections) (Saarinen, 1982; Schaefer, 1971);
- May reduce the severity of respiratory illnesses (Chiba et al., 1987; Downham et al., 1976; Pullan et al., 1980);
- May protect an infant against food allergies (Kramer, 1988);
- May have a long-term protective effect against some diseases, such as lymphoma (Davis et al., 1988), and type I diabetes mellitus (Borch-Johnsen et al., 1984; Mayer et al., 1988); and
- Is always available when the mother and infant are together.

For the mother, breastfeeding:

- Allows for quicker recovery from childbirth by helping the uterus to return to its nonpregnant size sooner;
- Suppresses ovulation for many women (Lawrence, 1989) (see Kennedy et al., 1989 and Perez, 1992, for more information). However, to assure that pregnancy is prevented in the postpartum period, alternate forms of birth control should be used;
- May be protective against breast cancer (Byers et al., 1985; Layde et al., 1989; McTierman and Thomas, 1986; Tao et al., 1988; Yuan et al., 1988), although there is conflicting evidence (Kvåle and Heuch, 1987; London et al., 1990);
- Is less expensive, more convenient, and requires no time for preparation (e.g., no sterilization and preparation of bottles is required);
- Eliminates concern over the quality and safety of the water added to formula;
- May have an effect on weight loss after childbirth in some women; and
- Stimulates the release of the hormone prolactin that brings a sense of relaxation and well-being to the mother.

For the above reasons, breastfeeding is beneficial for as long as a mother is interested in nursing and provides significant benefits even if she nurses for a limited time. Thus, interested women should be encouraged to nurse even for a short period or infrequent intervals.

Methods to Support Nursing Mothers in Your Program

Nursing mothers benefit from education, support, and encouragement provided by the health care team. Appropriate and accurate instruction and support can help women breastfeed successfully. Some methods to support nursing mothers

in your clinic or program site include the following:

- Make a place or room available for them to nurse their infants when they visit a clinic or program site;
- Offer all nursing mothers a list of professional and peer resources (i.e., area lactation specialists, peer counselors, public health clinic, WIC clinic, nursing mothers group, La Leche League, etc.) to contact for ongoing encouragement, information, equipment, and assistance if the mother is having nursing problems;
- Display culturally appropriate posters and materials on breastfeeding in the clinic or program site (and do not display formula and materials with formula brand names and logos in clear view);
- Convey positive attitudes towards and messages about breastfeeding in orientation and educational programs and materials for clients;
- Regularly provide individual counseling, group support classes, and educational printed materials and audiovisuals on breastfeeding which portray breastfeeding as the preferred infant feeding choice and are appropriate to the clients' cultural and ethnic background, language, and reading level. Encourage participation of the mother's family and friends in breastfeeding education and support sessions;
- Coordinate breastfeeding support with other health care programs in your community;
- If your program is in a hospital clinic, encourage hospital practices that are supportive of breastfeeding (for more information on supportive practices, see Spisak and Gross (1991) and USDA (1990));
- Make available peer support people and/or staff who can provide regular and ongoing counseling and support services to nursing women in the immediate and later postpartum periods;
- Refer nursing women who request infant formula to a nutritionist for nutrition assessment and counseling (e.g., if a nursing woman does not wish to totally wean off the breast, counseling can be provided on the approximate amount and form of infant formula, e.g., powdered, to feed); and
- *Do not give unwanted and unneeded formula to:*
  - New mothers who intend to breastfeed their infants, at the time of hospital discharge or other time, or
  - Mothers who do not express a desire and do not need to feed supplemental infant formula to healthy infants.

For more information on how to promote breastfeeding during the prenatal and postpartum periods and to remove barriers to breastfeeding, refer to the Selected Bibliography, pages 170-171.

Basic Background Information on Breastfeeding

This section covers basic information on how the breasts function to produce milk, the composition of breast milk, practical breastfeeding techniques and tips, planning for time away from the infant, some common concerns during nursing, concerns regarding the use of cigarettes, alcohol, certain beverages, and other drugs during lactation, contraindications to breastfeeding, and weaning the breastfed infant.

Since the following discussion of lactation management issues is relatively brief, a list of resource publications on breastfeeding is included in the Selected Bibliography on pages 171-172. The list includes references which provide additional information on breastfeeding techniques, solving breastfeeding problems, relactation, and breastfeeding in special circumstances, such as with twins, a premature infant, or after a Cesarian section birth. Counseling points related to the information presented in this chapter are found in chapter 7, pages 127-133.

How the Breasts Function to Produce Milk

During pregnancy, the breasts undergo physiological and anatomical changes which enable them to produce milk for an infant. The size of a woman's breasts does not affect her ability to breastfeed; women with small breasts produce the same quantity and quality of milk as those with larger breasts. However, a woman's breasts

should increase in size from pre-pregnancy to after delivery; if she expresses concern that there is no change in size, refer her to her health care provider.

Breast Structure and Function

The female breast, called the **mammary gland,** can manufacture milk from nutrients and substances that are drawn from its blood supply. The mammary gland is composed of different structures that produce breast milk. Figure 2, page 38, illustrates the structures described below.

The gland is divided into 15 to 20 **lobes.** Each lobe contains large numbers of smaller units called **lobules.** Each lobule is composed of clusters of **alveoli,** the part of the gland that produces the milk. Each alveolus contains clusters of special cells, called **secretory** or **alveolar cells,** in which breast milk is produced and then secreted. These secretory cells make the milk by extracting water, nutrients, and other substances from their rich blood supply. Milk-specific proteins, fats, and carbohydrates are produced in these cells to make the milk. Also, components of milk are produced by other cells in the gland and some components are transferred directly from blood plasma to the milk. The clusters of secretory cells are surrounded by **myoepithelial cells** which contract and squeeze the milk out of the alveoli into passages called ductules. The milk flows from the alveoli through **ductules** which branch out into larger **lactiferous ducts** (one stems from each lobe). The milk flowing out of these ducts collects in **lactiferous sinuses,** which are located in the breast underneath the **areola,** the dark circular area surrounding the nipple on the outside of the breast. When milk is in the sinuses, it is then available to flow out to the suckling infant through the nipple.

The **nipple** on the breast has the ability to become firm and protruded, making it easy for the infant to grasp. Yet, it is also sufficiently flexible so that it can be molded as needed in the mouth during nursing. Each nipple has openings at its end, called **ductulor orifices.** The milk flows through these orifices to the infant.

The areola contains small glands called **Montgomery's glands** along with oil-secreting **sebaceous glands.** The Montgomery's glands, which look like small bumps during the prenatal and lactation periods, secrete substances that lubricate and protect the nipple from bacteria.

Hormonal Control of Lactation

The process of milk production and secretion is under the control of the mother's nervous and hormonal systems. The suckling action of the infant at the breast results in a chain of events. The movement of the infant's mouth on the nipple and areola stimulates the nerves that travel to the hypothalamus in the brain which triggers the release of the hormones prolactin and oxytocin from the pituitary gland in the brain into the mother's bloodstream. Nursing after delivery and frequently thereafter around the clock, stimulates the release of these hormones. *These hormones help maintain the breast milk supply because:*

- Prolactin directs the secretory cells in the alveoli to produce breast milk. The frequent release of this hormone is necessary for continuous production of milk; and
- Oxytocin signals the myoepithelial cells in the alveoli and ducts to contract and squeeze milk down in the breast toward the nipple.

Thus, the more frequently an infant nurses effectively, the greater the production of these hormones, and the more milk his or her mother will produce.

The Let-Down or Milk Ejection Reflex

The action stemming from oxytocin release is commonly called the let-down or milk ejection reflex. *Signs of this reflex include the following:*

- Tingling, fullness, dull ache, or tightening in the breasts (although some do not feel any of these sensations);
- Milk dripping or spurting from the breast not being suckled during nursing; or
- Uterine cramping after the infant is put to the breast during the first few days postpartum.

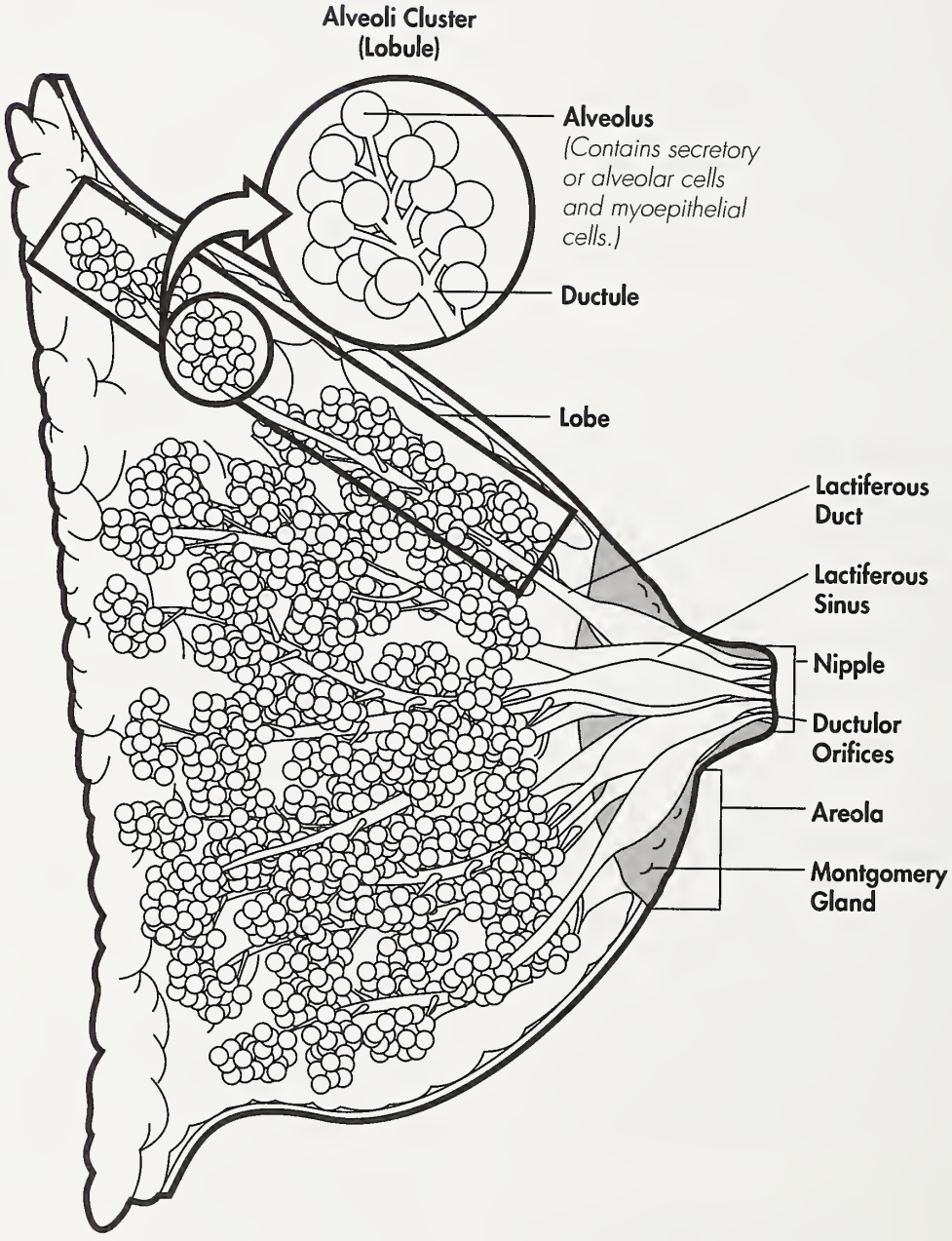


Figure 2: Diagram of Structures of the Breast During Lactation

Also, a woman may be able to tell that let-down has occurred and her milk is flowing by noticing that her infant swallows making gulping or quieter noises.

In the early postpartum period, the let-down reflex is primarily triggered by the infant's suckling on the breast. After this reflex is well established, let-down can occur due to a variety of other stimuli that the mother associates with the nursing process; i.e., when a mother hears her infant's cry, sees or thinks of her infant, or at the usual time of day her infant is breastfed even if the infant is not around. The let-down reflex is sensitive to a woman's psychological state and other factors. For example, a woman's let-down reflex may be inhibited if she is experiencing stress, sorrow, anxiety, fear, fatigue, embarrassment, or pain. If this reflex is inhibited, the milk will remain in the alveoli and ducts and the infant may have difficulty nursing and obtaining sufficient milk to meet nutritional requirements.

Methods to encourage the let-down reflex include the following (Mohrbacher and Stock, 1991):

- Relaxation exercises;
- Warm compresses before nursing (e.g., a warm washcloth on the breast);
- Breast massage;
- Nursing in a calm, undistracted setting; or
- Nursing while lying down.

If a woman expresses concern that her milk is not letting down, a person knowledgeable about lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) can provide assessment, counseling, and followup services.

After the let-down reflex has occurred, infants derive milk from the breast by the physical action of their tongue and jaws on the breast. When an infant draws the nipple into the back of the mouth and, with his or her tongue, rhythmically compresses the areola when suckling, milk is drawn down the lactiferous sinuses and out of the nipple. It is important for the infant's mouth to be correctly latched onto the breast in order for compression of the lactiferous sinuses to occur (latch-on is discussed on page 44).

Composition of Human Breast Milk

Human breast milk is distinct from the milk of other mammals and from infant formulas ordinarily derived from them. Human milk is unique in its physical structure, types and concentrations of protein, fat, carbohydrate, vitamins and minerals, enzymes, hormones, growth factors, host resistance factors, inducers and modulators of the immune system, and anti-inflammatory agents (IOM, 1991). Since breast milk composition changes during a feeding, through the day, and over time to meet each infant's nutritional needs, human milk cannot be defined as a discrete, singular, or unchanging substance. However, researchers can describe the general characteristics and contents of this uniquely designed human infant food.

Colostrum

The first milk that is produced by the breast for an infant right after birth is a thick, yellow-colored fluid called colostrum. The yellow color results from colostrum's high concentration of carotene (vitamin A precursor). Colostrum is rich in immunoglobulins that protect against bacteria and viruses. Colostrum, with its high-protein and low-fat content, is ideally designed to meet the nutritional needs of the rapidly growing newborn infant. Over the first 3 weeks after birth, the colostrum is gradually replaced by mature breast milk.

During the transition to mature milk, concentrations of fat and lactose increase in the milk while those of protein and minerals decrease. It is not recommended that women express any colostrum from their breasts before their infant's birth because it is thought that pumping of the breasts may stimulate uterine contractions, risking premature delivery, and that all the available colostrum should be saved for the infant (Lawrence, 1989).

Mature Breast Milk

Mature breast milk looks thinner than colostrum. Most breast milk is a watery, very pale blue color, and sometimes even pale green, yellow, or orange (certain foods with pigments can affect the milk's color) (Lawrence, 1989). While **foremilk**, the first milk available at the beginning of a feeding, may be pale blue or other colors,

hindmilk, the richer milk available toward the latter part of a feeding, is more opaque and may have a slight yellow cast. Infant formula is both more opaque and darker in color than breast milk. Some women may need reassurance that although their milk looks thinner than the richer-looking colostrum, mature milk is still full of nutrients for the infant.

Breast milk is a complex fluid that contains more than 200 recognized constituents (Blanc, 1981). Although the nutrient content of mature breast milk can be influenced by many factors, the milk has the following general characteristics:

Water

Mature breast milk is composed mostly of water. Evidence suggests that nursing mothers can tolerate a considerable amount of water restriction and that supplemental fluids consumed by a woman have little effect on milk volume (Prentice et al., 1984; Olsen, 1941; Lelong et al., 1949; Dusdieker, et al., 1985). If a woman consumes an inadequate amount of water during lactation, her body will compensate by reducing the amount of water lost through her urine and other routes so that the amount of water needed to make the milk is available (Lawrence, 1989). However, note that it is recommended that women drink sufficient fluids to alleviate thirst during the lactation period (IOM, 1991).

Lipids (Milk fat)

Approximately 50 percent of the kilocalories in the exclusively breastfed infant's diet come from the fat in breast milk (CON, 1992). Lipids (including fatty acids) are the most variable component in breast milk. The fat content of breast milk varies in concentration during a feeding, through the day, and over time as an infant gets older (Lawrence, 1989). The fat content of breast milk increases from the beginning to the end of a single nursing. Thus, a bulk of the energy content of a feeding is delivered during the latter part of each nursing. The fat content of milk also differs from one nursing to another in a nonconsistent manner and is influenced by the time between feedings (the longer the interval between feedings, the lower the fat content). To assure that the exclusively breastfed infant receives sufficient kilocalories, encourage nursing mothers to nurse frequently throughout the day and avoid limiting the duration of nursings (see pages 47-49 for information on nursing frequency and duration).

There is no compelling evidence that the amount of fat that a woman consumes influences the total quantity of fat in her breast milk (IOM, 1991). However, the type of fat that a woman consumes will influence the fatty acid composition of her breast milk (Jensen, 1989). For example, vegetarian women have breast milk much higher in polyunsaturated fatty acids compared to nonvegetarian women (Sanders et al., 1978). Studies have shown that the amount of body fat a woman has may influence the concentration of fat in her milk; i.e., the higher a woman's percentage body fat, the greater the concentration of fat in her milk (Prentice et al., 1981; Brown et al., 1986).

Breast milk contains approximately 10 times as much cholesterol as the amount in commercial infant formulas (Motil, 1987). There is no evidence that the concentration of cholesterol in breast milk can be altered by changes in a woman's diet (IOM, 1991). See pages 7-8 regarding fat and cholesterol in breast milk.

Protein

The protein in breast milk is uniquely different from cow's milk and commercial infant formulas. More specifically, breast milk contains:

- Approximately one third the amount of protein as cow's milk;
- Important protein-based substances with a protective role such as lactoferrin, lysozyme, and immunoglobulins (see page 41), that are not found in commercial infant formula or cow's milk;
- Different amounts and types of nucleotides (non-nitrogen-containing compounds used to make genetic material in cells) compared to cow's milk and commercial infant formulas (only some commercial infant formulas contain nucleotides);
- Significantly different amounts of amino acids compared to cow's milk. For example, breast milk contains high levels of taurine, low levels of phenylalanine and tyrosine, and a much lower ratio between the sulfur-con-

taining amino acids, methionine to cysteine, than cow's milk;
- More whey and less casein protein compared to cow's milk. Milk proteins are broadly classified into whey proteins and caseins. Casein protein in milk forms a curd when the milk is digested in the stomach or heated. When milk is curdled in that manner, the clear fluid that separates from the curd contains the whey protein. Breast milk is easier to digest than cow's milk because of its lower casein content; the curds from breast milk tend to be softer and easier to digest. Although some milk-based infant formulas have been formulated to contain a higher whey to casein protein ratio, the amino acid content of infant formulas is still different than human milk (this is because casein and whey amino acid composition is unique to each species) (Lawrence, 1989).

Carbohydrates

Of the many different carbohydrates in breast milk, lactose is the major one. Specific carbohydrates (nitrogen-containing sugars) may help to establish beneficial and protective micro-organisms (lactobacilli) in the lower intestinal tract of breastfed infants (György et al., 1974).

Vitamins

The vitamin content of breast milk is affected by the mother's vitamin intake and stores, but the effect varies with the vitamin. Chronic low dietary intake of vitamins may result in milk that contains low amounts of these essential nutrients. Refer to IOM (1991) for more detailed information on vitamins in breast milk. See pages 10, 8-9, 10-11, and 11, respectively, for more information on vitamins K, D, B_{12}, and thiamin, and breastfed infants.

Minerals

The concentrations of major minerals (calcium, phosphorus, magnesium, sodium, and potassium) in breast milk are not affected by the mother's diet (IOM, 1991). The concentrations of the trace minerals (iron, copper, zinc, manganese, selenium, iodine, and fluoride) in breast milk may be influenced to widely varying degrees by the mother's dietary intake (IOM, 1991). Refer to IOM (1991) for more detailed information on minerals in breast milk. See pages 13 and 15, respectively, regarding supplementation of iron and fluoride for breastfed infants.

Compared to human milk, cow's milk contains excessive levels of many minerals. This higher mineral level increases the renal solute load in cow's milk, making it an inappropriate milk for infants. Although human milk contains lower levels of many minerals than cow's milk or commercial infant formulas, these minerals are absorbed more efficiently. For example, infants absorb about 50 percent of the iron from breast milk compared with 7 percent from iron-fortified infant formula, 4 percent from infant cereals (Dallman, 1986), and 10 percent from cow's milk (Lawrence, 1989). Similarly, although the zinc, calcium, and phosphorus content in human milk is lower, these minerals are absorbed more efficiently from human milk than cow's milk (Lawrence, 1989).

Anti-Infective Factors

Breast milk contains antibodies and other anti-infective factors that are thought to have a protective effect and are not found in commercial infant formulas. These anti-infective factors include the following:

- **Lactoferrin**—This protein slows the growth of harmful bacteria in a breastfed infant's intestines by binding with iron and making it unavailable to the bacteria (Bullen, 1978; Stephens, 1980). Certain forms of lactoferrin that do not bind with iron may inhibit the replication of some viruses (Furmanski et al., 1989).
- **Lysozyme**—This enzyme destroys specific types of susceptible bacteria (Chipman and Sharon, 1969) and it acts in concert with other components to kill other harmful micro-organisms.
- **Immunoglobulins**—These substances protect the infant against harmful micro-organisms that infect the gastrointestinal tract.
- **Bifidus factor**—Several nitrogen-containing carbohydrates are present in high concentrations in colostrum and mature human milk. These carbohydrates have "bifidus factor"

activity which promotes the growth of beneficial bacteria, *Lactobacillus bifidus*, and helps control the growth of undesirable bacteria in the infant's intestines (György, 1953; Lawrence, 1989).

- **Other protective substances** such as: macrophages, polymorphonuclear leukocytes, antiviral lipids, antistaphylococcal factor, T and B lymphocytes, B_{12} binding protein, fibronectin, complement (C3 and C4), lactoperoxidases, and interferon (IOM, 1991; Lawrence, 1989).

Other Substances in Mature Milk

Breast milk also contains a variety of other substances including enzymes, prostaglandins, many hormones, bile salts, lipases, anti-inflammatory agents, and growth factors (IOM, 1991; Lawrence, 1989).

Practical Breastfeeding Techniques and Tips

Breastfeeding is a learned process on the part of both the mother and infant. To facilitate a mother's adaptation to and comfort with breastfeeding, she can benefit greatly by receiving anticipatory guidance. Once a mother knows what to expect and how to handle problems in advance, she can better prevent and cope with most nursing problems which might occur. This section reviews basic information and techniques that can assist mothers in having a successful nursing experience. Since this section primarily provides an overview of breastfeeding techniques, refer to textbooks noted in the Selected Bibliography on pages 171-172 for additional information.

Comfort During Nursing

Breastfeeding is easier and more enjoyable when the mother and infant are able to nurse in a relaxing setting. Encourage a woman to find a comfortable place for nursing. In the early weeks postpartum, a woman may be more comfortable during nursing if she has privacy and can relax with her infant. During this period, encourage mothers to take time to interact and learn about their infants.

Feeding Positions

The way a mother holds her infant and the position of the infant on the breast can influence successful nursing. Incorrect positioning can make it difficult for an infant to suckle properly on the breast, result in inadequate milk consumption by the infant, and lead to sore nipples. To help a woman learn holding positions, try demonstrating them using a doll. Reference publications on lactation management in the Selected Bibliography include information on nursing positions for twins.

Holding the Infant There are three commonly used positions that allow an infant and mother to breastfeed comfortably. In these positions, the infant's neck should be straight to enhance swallowing. When instructing a mother on these positions, it may be helpful to tell her that one guideline is to situate her infant in a "tummy to tummy" or "chest to chest" position with her. The following positions are illustrated in figure 3, page 43.

Lying Down

In this position, the mother lies on her side with pillows under her head and behind her back. The infant would be lying on his or her side facing the mother with his or her stomach to the mother's stomach, and with the infant's mouth up to nipple level. Small pillows can be placed either under the infant's head to bring the infant's mouth to nipple level or under the mother's arm which is holding the infant. She can shift her body or roll to the other side with the infant to switch breasts, being careful not to let the infant pull down on the nipple.

Across the lap or cradle hold

In this position, the mother sits upright in a chair or couch with her back supported while cradling her infant. The mother supports the infant's head with her arm and rolls the infant on his or her side with the infant's stomach facing the mother's stomach. It is easier for the mother to support her infant up to the level of her nipples if she places one or more pillows on her lap under the infant. Alternately, she could cross her legs and bring the infant up to nipple level with her raised leg. The infant

should be very close to the mother and horizontal at her waist, with the infant's legs tucked under her other breast. To prevent straining her back, the mother should avoid leaning down to the infant and instead bring the infant to her.

Football Hold

In this position, the infant's torso would be held on the side of the mother's body and supported by a pillow. The infant's stomach is against the side of the mother's stomach, and his or her feet are towards the mother's back. The infant's head is facing the mother's nipple and is supported by the mother's hand which can raise the infant's head to the breast. It is best for the mother to avoid leaning down toward the infant (this could strain her back) or pushing his or her head into her breast.

Across The Lap or Cradle Hold

Football Hold

Lying Down

Figure 3: Common Breastfeeding Positions

Illustrations courtesy of the State of California, Department of Health Services, Maternal and Child Health Branch, Woman, Infants, and Children Special Supplemental Food Branch.

The Australian hold or Posture feeding position (see figure 4, page 45) is sometimes recommended for women who have an overabundance of milk or a very strong milk ejection reflex. In this position, the mother lies on her back with her infant lying on top of her, with the infant's stomach on the mother's stomach. To position the infant easily, the mother can put her infant to the breast while sitting and then lie down with the infant. Gravity will cause the milk to flow slower when the infant suckles. This position is not ideal for regular use for infants in general because of the possibility of incomplete emptying of the breasts (Lauwers and Woessner, 1989).

Attachment ("Latch-on") to the Breast
Before positioning the infant to start nursing, it is advisable for women to wash their hands. The position recommended to hold the breast while nursing is the C-hold or Palmar grasp. This hand position involves placing only the thumb on the top of the breast, with the other four fingers on the bottom of the breast to lift and support it. It is best for the fingers to avoid covering the areola, the infant's latch-on site. With the breast well supported, the nipple and breast can be easily directed into the infant's mouth. See figure 5, page 46, for a diagram of this position. Especially for young infants, it is helpful for the mother to support the breast in this manner during nursing.

A mother can initiate breastfeeding by stroking the lower lip of the infant with the nipple of the breast she is holding. The infant will respond by opening his or her mouth, ready to accept the nipple. When the mouth is wide open and the infant's tongue is down on the floor of the mouth, the mother should move the infant quickly onto the breast. It is important to make sure that the infant has both the nipple and most of the areola in his or her mouth with his or her lips sealed around the areola. When the infant suckles in this position, the infant's gums press against the base of the areola causing the milk to eject into the mouth.

When attached properly, the infant's nose should be touching the skin of the breast (the infant's nose is designed to permit breathing during nursing). The infant's lips should be flanged out (curved outward) and relaxed with neither the upper or lower lip curled inward.

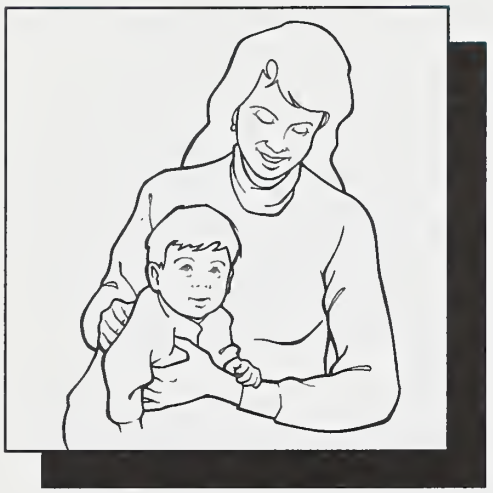
If the infant is not attached correctly the first time, a mother may need to repeat the attachment procedure until her infant is latched on properly. Reassure her that sometimes she may have to try a couple of times to get a good latch-on. If a mother experiences any tenderness during latch-on in the early weeks of nursing, it should subside after the first 30 seconds to 1 minute if the infant is properly attached to the breast.

An infant will receive little milk if suckling occurs while only the nipple is in his or her mouth. This is because an infant's mouth needs to rhythmically compress the milk-containing lactiferous sinuses, located under the mother's areola, in order to both draw the milk out and to provide the stimulation needed to bring on the let-down reflex. An infant's attempts at trying to suck for milk when attached only to the nipple may result in inadequate milk production and nipple soreness.

Coming Off the Breast Some infants, when they are finished nursing, will automatically come off the breast. A mother can either wait until the infant stops suckling and comes off the breast, or break the suction between the mouth and breast by slipping a finger down into the corner of the infant's mouth under the gums until the release can be felt or heard. If a mother just pulls her infant off without breaking the suction first, she could hurt her nipple.

Figure 4: Australian Hold or Posture Feeding Position

Figure 5: Position to Hold the Breast With the Hand (C-Hold or Palmer Grasp)



Burping

It is generally recommended that breastfed infants be burped at least once between feedings on each breast and after a feeding is over. Interrupting a nursing to burp the infant is disruptive to the feeding rhythm. Therefore, it is best to burp the infant gently at natural breaks in the feeding. These feeding breaks are good times for the caregiver to socialize with (e.g., talk gently and smile at) her infant. An infant can be burped by gently patting or rubbing the infant's back while he or she is held against the front of the caregiver's shoulder and chest or held and supported in a sitting position in the caregiver's lap.

Frequency and Duration of Feedings

Frequency of Feedings Breastfed infants should be fed when they show signs of hunger. Healthy, normal infants express signs of hunger and satiety and expect their caregiver to respond to these cues. Thus, putting healthy exclusively breastfed infants on a strict feeding schedule is generally not recommended. Encourage mothers to watch their infants for signs indicating hunger and to put them to the breast when they see those signs. Signs of hunger include the following:

- Rooting reflex (see page 29 for the definition);
- Hand-to-mouth activity (e.g., sucking on hands);
- Small fussing sounds;
- Pre-cry facial grimaces (i.e., the infant looks like he or she is about to cry); and
- Crying (mothers should check if the infant is crying for other reasons before assuming he or she is hungry).

Since it is normal for infants to have fussy times, an infant may cry and just want to be held or to suck and may not actually be hungry. If you perceive that a caregiver is troubled by or not coping with an infant's fussiness or crying, refer him or her to a health care provider for further assessment and assistance.

In general, frequent nursing helps to maintain and increase a mother's breast milk supply. Exclusively breastfed infants nurse an average of 8 to 12 times in 24 hours (or about every $1^1/_2$ to 3 hours) in the first 2 weeks of life (DeCarvalho et al., 1982; Yamauchi and Yamanouchi, 1990) and gradually reduce their nursing frequency to approximately 6 to 8 feedings per 24 hours by 4 months old (Butte et al., 1984). From 4 weeks to 6 months of life, infants nurse approximately every 2 to 4 hours, and may also sleep longer overnight. As an infant gets older, the amount of time between feedings will increase. However, after a usual pattern of nursing is established, an infant may suddenly demand to be nursed more frequently, e.g., during appetite spurts (resulting from growth spurts) or when teething. Also, the longer an infant sleeps at night, the more frequently the infant may demand to be nursed during the day.

The interval between hospital discharge and the first well baby visit is a critical period for establishing lactation. Inadequate nursing frequency

during this time will decrease milk production causing lactation failure within 2 weeks of birth. If a newborn infant is nursing fewer than 10 times per day and is not gaining weight properly, encourage the mother to nurse more frequently—every $1^1/_2$ to 2 hours during the day and every 3 hours at night—until the infant's weight gain has significantly improved (Mohrbacher and Stock, 1991).

Sleepy or Placid Infant An exception to using the demand feeding approach is for a young breastfed infant who is lethargic and sleepy or placid. Some infants may either fall asleep after being at the breast for a short time, may not be easy to wake for feeding every 2 to 3 hours, or do not show signs of hunger normally. Placid and nondemanding breastfed infants, who fail to "act hungry" and as a result are not nursed often enough, may become malnourished (Davies and Evans, 1978). To assure that such infants obtain sufficient nourishment, it is advisable for mothers to wait no more than 4 hours (or sooner if the infant's health care provider indicates) between feedings until the infant's first well baby visit (between 2 and 4 weeks old). At that time, the infant's health care provider should be consulted regarding continuation of that practice based on the infant's weight gain. It would be appropriate to refer an infant, whose caregiver complains of the infant's sleepiness or lack of hunger signs, to a health care provider for further assessment. Feeding throughout the night is not usually necessary for the older infant with a normal growth rate.

To wake a sleepy infant, a mother can try these methods:

- Playing with and talking to the infant;
- Holding the infant in an upright position (sitting or standing) several times;
- Rubbing the infant's hands and feet;
- Unwrapping or loosening blankets;
- Giving the infant a gentle massage; or
- Changing the infant's clothing or diaper.

Nursing Frequency and Engorgement Some mothers of young infants who go for more than 3 to 4 hours without nursing may experience their breasts becoming engorged with milk. This uncomfortable condition hampers the infant's ability to latch on and nurse, and thus, to consume an adequate quantity of milk. Ultimately, infrequent nursing can lead to inadequate removal of milk from the breasts and may cause weight loss or poor weight gain in the infant. Note that there is some normal engorgement that occurs in the first few weeks of lactation caused by an increased blood flow to the breasts and a temporary swelling of the breast tissue (frequent nursing during the first few weeks after birth will not decrease this normal engorgement).

In summary, the average number of feedings to expect for an exclusively breastfed infant at different ages is as follows (DeCarvalho et al., 1982; Yamauchi and Yamanouchi, 1990; Butte et al., 1984):

Age of Infant	Average Number of Feedings per 24 hours if Exclusively Breastfed
Birth to 4 weeks	8 to 12
1 to 2 months	7 to 10
2 to 4 months	6 to 9
4 to 6 months	6 to 8

Duration of Feedings From the first feeding, mothers should follow their infants' lead in determining the length of each nursing. Infants should be allowed to continue for as long as they indicate the desire to nurse. Over the first 4 months, the average exclusively breastfed infant nurses between 10 and 20 minutes per breast for a total nursing period of 20 to 40 minutes. Some infants are very "efficient" nursers and will spend less time on the breast while others are slower nursers and tend to spend more time at the breast.

Breastfeeding experts feel that limiting feeding time in the first few weeks of life may (L'Esperance and Frantz, 1985; Riordan and Auerbach, 1993; Whitley, 1978):

- Delay rather than prevent nipple soreness;
- Interfere with the development of the let-down reflex, if the feeding is very short; and
- Decrease the amount of nutrient- and energy-rich hindmilk that the infant receives.

Therefore, a time limitation on nursing, especially in the initial months, is not recommended.

In summary, encourage a nursing mother to:

- Allow her infant to determine the length of the nursing period;
- Allow her infant to come off the first breast on his or her own before offering the second breast (sometimes, an infant may not want to nurse at the second breast, then, just start with that breast at the next feeding); and
- Alternate the breast which begins each feeding (i.e., if the last feeding began on the right, begin the next feeding on the left breast). Since an infant's suckling is generally most vigorous at the beginning of a feeding, this practice gives both breasts a chance to be more vigorously stimulated at every other feeding. Mothers can place a safety pin on their clothing over the breast that they intend to begin with for the next feeding as a reminder.

An infant may be full and satisfied from a feeding if he or she shows lessened interest in continuing with nursing (e.g., the infant comes off the breast and does not indicate a desire to continue on the same breast or second breast by turning away, closing his or her mouth, etc.) or shows more interest in other things around him or her besides nursing.

Indicators of Whether An Infant is Consuming Enough Milk

Nursing mothers may ask how they know if their infants are obtaining sufficient breast milk. This feeling may occur because they cannot see how much milk is consumed. They also may notice their breasts decreasing in size from their initially swelled size over the first few weeks after birth (this slight shrinking of breast size is normal).

To reassure women that their milk supply is adequate and that their infants are consuming a sufficient amount of milk, specific indicators can be examined. *An exclusively breastfed infant is probably consuming a sufficient amount of breast milk if he or she:*

- Is gaining weight consistently even if slowly (e.g., about 4 to 8 ounces per week on the average in the first 6 months, and about 3 to 5 ounces per week during the second 6 months); this is the most important indicator of whether an infant is receiving sufficient milk and nursing effectively. Infants generally double their birth weight by age 4 to 5 months, and triple their birth weight by 12 months. See page 3 regarding the growth rate of breastfed infants.
- Nurses an appropriate number of times in 24 hours for his or her age (see pages 48 and 108);
- Can be heard swallowing consistently while nursing (in a quiet room);
- Urinates to the degree that the caregiver changes about 6 to 8 thoroughly wet cloth diapers or 5 to 6 thoroughly wet disposable diapers (disposable diapers absorb and hold more liquid than cloth diapers) in 24 hours, while not being given any extra fluids besides breast milk;
- Excretes urine which is pale yellow or clear; and
- Has multiple bowel movements each day during the first 6 weeks of life. Some infants have a bowel movement with every nursing; an infant who has fewer than 4 per day may not be consuming a sufficient quantity of milk. After 6 weeks, the number of bowel movements can vary from less than once a day to many per day.

If there is any question whether the infant is receiving adequate nourishment, it would be appropriate to:

- Assess the infant's dietary intake and growth (using NCHS growth charts) at initial and followup visits; and
- Consult with and refer the infant for regular followup to a health care provider and, if necessary, other persons trained in lactation management.

Supplementary or Complementary Bottles

Supplementary bottles are bottles of infant formula or other liquid fed in between nursings; complementary bottles are bottles fed right after a nursing to "top off" the nursing. If supplementary or complementary bottles of infant formula are given during the first 2 to 4 weeks after birth before lactation is well established, the infant may:

- Suffer from nipple confusion; this may occur because artificial nipples on bottles and pacifiers require different movements of the infant's tongue, lips, and jaw, and may make it difficult for infants to easily go back to the mother's nipple and breast;
- Develop a weak suck;
- Refuse the breast; after being on a bottle, the infant may become frustrated and not express as much interest in suckling from the breast; and
- Fill up on formula and suckle less on the breast, causing a reduction in milk production.

Infants who develop any of the above problems can be referred to someone trained in lactation management for assistance. Women who are trying to establish their breast milk supply are generally advised to avoid feeding supplementary or complementary bottles of infant formula or water, or using pacifiers, for the initial 2 to 4 weeks of an infant's life (Riordan and Auerbach, 1993). After lactation is well established, occasional supplementary bottles of infant formula should not necessarily have a detrimental effect on the continuation of exclusive nursing. Note that feeding infant formula during a nursing using a nursing supplementer may be recommended under certain circumstances (see page 51).

Some women may wish to partially breastfeed and feed some infant formula. It is possible to combine both breastfeeding and formula feeding. However, as a woman increases the amount of infant formula fed and decreases the number of nursings, her breast milk production will decrease, possibly resulting in total weaning.

If a woman desires to wean her infant from the breast over the first few weeks of life, supplementary bottles of infant formula can be given gradually as she weans. See page 61 regarding weaning.

See pages 18-19 on additional concerns about feeding supplementary bottles of water.

Aids and Devices for Breastfeeding

Elaborate equipment is not needed in order to breastfeed. There are some aids and devices that can assist a mother in avoiding nursing problems and others that should be used with caution or avoided. See figure 6 for illustrations of some aids and devices. Some of these items include:

Nursing Bras (Brassieres) Nursing bras are specially designed to allow a woman to open a flap of the bra over each breast separately so that she can easily feed her infant with one breast at a time. If a woman chooses to wear such a bra, she may wish to shop for one a week or two before delivery when her breasts will be close to the size they will be during nursing (after delivery, she can select additional bras to fit her size). *The ideal features of a nursing bra include the following* (Huggins, 1990):

- Made of cotton with plastic-free cups; this permits air circulation and allows any leaked milk to easily dry and not remain wet against the nipple for an extended period;
- Nonelastic straps for sufficient support;
- Front flap fasteners that are easy to manage with one hand; and
- A good fit and not too tight to avoid placing excessive pressure on the ducts in the breasts.

It is most ideal to select a bra with room inside for nursing pads (see below) and, if used, breast shells (see below). Generally, underwire bras are not recommended during the lactation period.

Note that wearing a bra is not necessary when a mother is sleeping. If a mother chooses to wear a bra while sleeping, it should be loose fitting and as nonbinding as possible.

Nursing Pad These pads are placed in a bra to soak up leaking milk. Only cotton nursing pads without plastic or waterproof liners are recommended. It is best to change cloth nursing pads frequently to assure that moisture is not sitting on the nipples. Alternatives to commercial nursing pads include: cotton handkerchiefs, or squares cut from terry cloth, cotton diapers, or cotton T-shirts. Note that using toilet paper or facial tissues alone is not recommended because they dampen easily and hold liquid against the nipple.

Breast Shell (or Milk Cup) A breast shell (milk cup) is a two-piece hard plastic "device," which includes an inner donut-shaped portion and an outer portion with multiple holes—these are meant to be worn in the bra over the nipple. The large hole in the middle of the inner portion allows the nipple to protrude and multiple small holes on the outer portion allow for adequate air circulation around the nipple (shells without the multiple holes are not recommended). Sometimes these may be used to correct or relieve:

- *Inverted nipples* (nipples which do not protrude properly; see page 56 for more information)—The shells may be used during the end of pregnancy and sometimes after birth. By naturally producing steady mild pressure at the base of the nipple, it pulls the nipple out and breaks adhesions holding the nipple; and
- *Sore nipples* (see page 56 for more information)—Sometimes the shells are used to promote healing by allowing air to circulate around the nipple while not touching it. Breast shells may be used between nursings during the postpartum period.

Note that one study suggests that the use of breast shells during pregnancy may reduce the chances of successful breastfeeding because of negative experiences that women have in using the shells (Alexander et al., 1992). Women should follow advice from someone trained in lactation management on the proper use of breast shells. If a woman has or thinks she has inverted or flat nipples, refer her to someone trained in lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) for assistance.

Nursing Supplementer (Feeding Tube Device) The feeding tube device provides an infant with formula or expressed breast milk through a tube, which connects to a reservoir (plastic bag or bottle) supported between the mother's breasts. It is used to:

- Provide supplemental nutrition to preterm infants and infants with a weak suck or a need for extra supplementation (e.g., infants with neurological impairment, cardiac disease, cleft palate, or Down's Syndrome);
- Stimulate milk production without using bottles;
- Facilitate nursing an adopted infant; and
- Help a woman who wishes to return to breastfeeding after she has stopped.

Before this device is recommended to a mother, an assessment of the situation should be performed and basic lactation management attempted (there may be less expensive and less equipment-intensive methods which may work).

Nipple Shield A nipple shield is an artificial rubber latex or silicone nipple which rests on a mother's nipple while she is nursing. Nipple shields have been used by some women who believe they relieve sore nipples, however, they do not prevent sore nipples, nor correct their underlying cause. *These devices are generally not recommended for the following reasons:*

- They interfere with the milk supply by reducing nipple stimulation and preventing adequate compression of the milk sinuses;
- Infants may refuse to nurse without the shields if they become accustomed to nursing with them;
- Since the nipples on these shields are different than a human nipple, they may lead to nipple confusion (see page 50); and
- Infants obtain less milk when suckling on the breast through nipple shields.

If a woman is using the shields and having trouble weaning her infant off them, a person trained in lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) can provide assistance and explain how to re-establish correct latch-on and nursing on the breast.

Bowel Movements of Infants

The bowel movements of breastfed infants are different in color, consistency, and frequency than those of formula-fed infants. In the first few days after birth, all infants eliminate the meconium (excrement in the intestines of the fetus) which is sticky and a very dark color (greenish black). After that, the stools of an exclusively breastfed infant generally look like cottage cheese with the color of mustard (although they may be a darker brown or green color), and have a faintly sweet odor. The stools of formula-fed infants are darker and more formed than those of breastfed infants and they have the characteristic odor of the adult stool. Older breastfed infants may have one to eight or more bowel movements in one day and very young infants may have a bowel movement with almost every feeding. After the first 6 weeks of life, some infants may even have less than one bowel movement per day.

Breast Care

Women who adopt certain breast care practices can minimize the development of some common nursing-related breast and nipple problems. Breast care practices that are and are not recommended include the following:

Recommended breast care practices

- *Keep nipples dry between feedings*
  Moisture and darkness, as found under clothing in a bra wet from leaking milk, can promote bacterial or fungal growth. When the nipples are air dried after nursing and dry nursing pads or similar dry breathable cloth are placed into the bra or the bra flaps are left open (if a bra is worn), drying is enhanced. It is best to change the pads or cloth as soon as possible after they become wet. It is beneficial for a mother to expose her nipples to air and light (sunlight or can sit under a 60-watt bulb) for a short while after nursing **when possible**. Drying of the nipples and exposure to light may help to prevent infection from developing on irritated or cracked nipples. Expressing some milk onto the nipples at the end of a feeding and letting it dry may help sore nipples.
- *If the nipples are washed, generally use plain, clean water*
  Excessive use of "drying agents" (soap, shampoo, detergents, or alcohol) on the nipple and areola removes natural lubricants from them. Soap or shampoo that drips onto the nipples or areolae during a bath or shower can be rinsed off with plain, clean water. Excessive washing which includes rubbing may remove the protective outer layer of cells on the nipples and areolae.

Breast care practices that are <u>not</u> recommended

- *"Toughening" the nipples by rubbing them with a towel or other cloth*
  This practice can remove natural lubricants and some of the outer cell layer from the breast and increase irritation to the nipple.
- *The use of creams, ointments, or oils on the nipples or areolae on a **routine** basis to heal sore nipples, abrasions, or cracks*
  Under normal circumstances, the nipple and areola do not require application of creams or ointments because they are naturally oiled by the sebaceous and Montgomery glands in the areola (Lawrence, 1989). Creams and ointments do not prevent nipple soreness and should not be used as a substitute for determining and correcting the cause of a mother's sore nipples (Mohrbacher and Stock, 1991). **Routine** application of certain types of creams, ointments, or oils may be detrimental because they:

  - Hold moisture continually on the nipple and plug up the glands on the areola (e.g., petrolatum-based or vitamin A and D ointments), and may irritate the nipple (Lawrence, 1989);
  - Could cause allergic reactions in the woman (Lawrence, 1989; Mohrbacher and Stock, 1991);
  - May be unsafe for women and infants, unless specifically prescribed (Lawrence, 1989; Mohrbacher and Stock, 1991); and

- May change the taste of the breast which can make the infant fussy or refuse the breast (Mohrbacher and Stock, 1991).

Any ointments or creams used, for example, for medical reasons, should be safe for human consumption and not require wiping off before a woman nurses (wiping off will irritate sore nipples) (Mohrbacher and Stock, 1991). Women complaining of dryness of the nipples can discuss this problem with someone trained in lactation management.

Expression of Milk

A woman may need or want to express some of her breast milk under these circumstances:

- If her breasts are engorged with milk;
- To collect milk for feeding to her infant, e.g., if milk is needed while the infant is with a babysitter or in day care, or if someone other than the mother wishes to feed the infant; or
- To collect milk for a sick or hospitalized infant who is not nursing at all or for a premature infant.

All nursing mothers can benefit from knowing how to express their breast milk. Breast milk can either be expressed by hand or by using a mechanical manual or electric breast pump. A variety of resources are available which include instructions on hand expression of breast milk (see, for example, Huggins, 1990; Lawrence, 1989; Mohrbacher and Stock, 1991). For instructions on the use of manual or electric breast pumps, refer to the manufacturer's instructions for the specific pump. If instructions are not available, consult with someone trained in lactation management or the manufacturer.

In preparing to express milk, it is recommended that mothers:

- Wash their hands to avoid contaminating the milk;
- Express the milk by hand or using a thoroughly clean pump; and
- Collect the milk in a very clean container (rigid plastic or glass containers are generally recommended). See below on safe handling, storage, and preparation of expressed breast milk for feeding.

See pages 39-40 on the appearance of human milk. It does not look as "rich" as formula, even though it is. Since human milk is not homogenized, the fat in it will separate and come to the top. Also, if it sits for a while, there may be small lumps of cream that do not dissolve. These characteristics are all normal.

Storing Expressed Breast Milk Expressed breast milk is a perishable food which must be stored properly in order to be safe for consumption. *The following guidelines are recommended to prevent spoilage of breast milk:*

- Store bottles of breast milk in a properly functioning refrigerator or freezer after collection. Use refrigerated bottles of breast milk within 48 hours from the time they were prepared. (Although some researchers suggest that breast milk may remain safe for consumption if stored in the refrigerator for longer than 48 hours (Barger and Bull, 1987; Sosa, 1987), safety is assured with the 48-hour limit). Since refrigerators may be opened regularly, it is advisable to store the milk in the back section of the refrigerator, which tends to be colder than the front or door.
- If a refrigerator or freezer is not available (e.g., at work or school), the milk can be stored for a short time in a cooler packed with ice, or in an ice pack, until brought home for refrigerator storage.
- If planning to freeze breast milk, freeze it immediately after collection in portions generally needed for a single feeding (e.g., 2 to 3 ounce portions for most infants less than 3 months old; 3 to 4 ounce portions for infants 3 to 5 months old; 4 ounce or larger portions for infants 6 months and older). Also, some 1 ounce portions can be frozen for times when the infant wants some extra milk. When filling a bottle, leave room (about 1 inch) at the top for expansion.
- Store expressed breast milk in clean glass or rigid plastic bottles or disposable plastic nursing bags, tightly capped after filling (sterilized bottles and parts should be used for infants less than 3 months old) (see pages 77-78 on sterilizing bottles). With disposable nursing bags, there is a chance of bag breakage. If disposable nursing bags are used, it is

best to double them to avoid breakage when frozen (Lawrence, 1989; Riordan, 1983).

- Frozen breast milk can be stored for up to 3 months in a properly functioning self-contained freezer unit (temperature should be 0 ° Fahrenheit or below) attached to a refrigerator. Since freezers may be opened regularly, the temperature may not always be 0 ° Fahrenheit (temperature can be checked with a special thermometer). If the freezer is not working or if there is a power failure, frozen milk may thaw out and become rancid and spoiled before 3 months (if you notice your frozen foods thawing or becoming soft, have your freezer checked). Label the container of milk for storage with the collection date. Use the oldest milk first.
- Once frozen breast milk is thawed, use it within 24 hours and do not refreeze it. If the milk has an offensive odor when thawed, it may have spoiled and should be discarded. Also, do not add warm milk to cold or frozen milk. While breast milk is very resistant to bacterial growth when fresh, it is much less resistant after it has been frozen. Each time a liquid is added to frozen milk, a thin layer of milk thaws which is a potential area for bacterial growth. While the risk is small, the best policy is not to open stored milk until feeding time.
- If traveling with bottles of expressed breast milk, store them in a cooler with ice or an ice pack.
- Clean used bottles and their parts with soap and hot water, and bottle and nipple brushes, and then, if the infant is less than 3 months old, sterilize those items in boiling water, as shown in figure 7, pages 80-82, or wash in a dishwasher before reusing.

Warming Expressed Breast Milk. The following guidelines are recommended to thaw and warm breast milk:

- For infants who prefer a warmed bottle, warm it immediately before serving. A safe method of warming a bottle of refrigerated breast milk is to hold it under running warm tap water. Shake the bottle before testing the temperature.
- To thaw and warm a container of frozen expressed breast milk:
  - hold the bottle under running cool water and then under running warm water, and
  - shake the bottle gently to mix (breast milk separates into a fatty layer and a watery layer when it is stored).

  Avoid too much heat or shaking because heat will damage the protective substances in the milk and very vigorous shaking will cause the milk fat to separate out.
- Always test the temperature before feeding to make sure that it is not too hot or cold (test by squirting a couple of drops onto the back of your hand). Use the milk immediately after warming to avoid breakdown of the milk fat, the development of rancidity, and bacterial growth.
- Thaw and/or warm only as much breast milk as you think will be needed for a feeding.
- **Never use a microwave oven to thaw or warm breast milk because this practice is dangerous.** Liquid in a bottle may become very hot when heated in a microwave oven and remain hot after removal from the oven even though the bottle feels cool. Infants have been seriously burned while being fed liquids warmed in microwave ovens. Covered bottles can explode when heated in a microwave oven. Also, protective substances in breast milk can be destroyed if the milk is heated in a microwave oven.

Planning for Time Away From the Infant

Many mothers need or want to return to work or school outside their home shortly after their infant's birth. Mothers who must be separated from their infants for long periods can successfully continue to nurse them. Some mothers may wish to leave their infants with another caregiver occasionally.

The following tips may improve a nursing mother's ability to continue breastfeeding whether she chooses to work, go to school, or leave her infant temporarily in someone else's care:

- ***Delay the return to work or school until the infant is at least 4 to 6 weeks old.*** The period from birth to 4 to 6 weeks is prime for establishing a mother's milk supply. If a mother returns to work or school before that

time and is away from her infant for long periods, she may have difficulty maintaining her milk supply.

- ***Learn how to express breast milk by hand or by using a breast pump.*** A mother who is comfortable expressing breast milk by hand or using a breast pump can collect her milk while away from her infant. Mothers who begin expressing, collecting, and freezing small amounts of milk each day are able to build up a stored supply of milk. Thus, some recommend pumping twice a day, in addition to nursing the infant, beginning several weeks before the return to work or school—this allows the milk supply to increase gradually over the weeks. See above pages on milk expression.
- ***The easiest time to express milk to build up a supply is in the morning.*** Most mothers have more milk in the morning, and find that it is easiest to express then. One technique that works well for many mothers is as follows:
  - Nurse the infant from one breast after waking up in the morning.
  - Put the infant down, and pump the milk from the other breast and store it.
  - As soon as the pumping is finished, let the infant nurse on the side that was just pumped.

  Infants will usually consume the remaining milk that the pump did not extract. The extra suckling will also increase the mother's milk supply.
- ***Inquire about breastfeeding support at the workplace/school.*** Some workplaces or schools may feature supportive policies (e.g., allowing breaks or flexible work hours for pumping or breastfeeding) and facilities for nursing mothers (e.g., special rooms or areas for nursing with privacy, an electric breast-pump for employees' use, and a refrigerator to store expressed milk).
- ***Nurse the baby when home; Express milk during the day if possible.*** In order to maintain her milk supply and avoid engorgement and breast infections, a mother should try to nurse her infant sometime before she leaves for work or school, after she comes home for the day, and in the evening, and, if possible, express her milk during the day. Mothers often try to express their milk during breaks and/or lunch hour. Some mothers go to their infants or have their infants brought to them for nursing at lunch time. Alternately, when milk expression is not possible, infant formula can be provided while the mother is away. Some infants may wait until their mothers arrive home to do most of their feeding; this is not a problem as long as the infant is consuming an adequate amount to maintain proper growth.
- ***Make arrangements for safely storing expressed breast milk while away from home.*** It helps if a refrigerator is available for storage at the worksite or school. If not, some mothers store their milk in coolers packed with ice or ice packs. See pages 53-54 for information on storage of expressed milk. Encourage the mother to label the container of milk for storage with the collection date. Then, the oldest milk should be used first.
- ***Make arrangements for child care for the infant.*** A mother can use a babysitter in her home or elsewhere, or a day care center. She can try to choose a babysitter or day care center that is supportive of breastfeeding and, in the case of the center, allows her to nurse if she visits. The temporary caregiver needs to be instructed on:

  - How to use frozen breast milk (see page 54 for instructions); and
  - How much expressed breast milk (or infant formula) the infant usually consumes and how often he or she usually eats (this will depend on the infant's stage of development and other factors). The temporary caregiver should still be encouraged to follow the infant's lead in deciding when and how much to feed.

- ***Introduce the infant to drinking from a bottle and to being fed by someone else besides the mother.*** An infant who will be fed by someone else needs to be introduced to a bottle before his or her mother starts going to work or school—some recommend 2 weeks before she returns and preferably no sooner than when the infant is 3 to 4 weeks old. By that age, the mother's milk supply should be established and there will be less

chance of causing nipple confusion in the infant.

- ***Nurse regularly on weekends and evenings.*** Nursing mothers decrease their chances of experiencing discomfort, engorgement, and a lower milk supply if they nurse frequently on evenings and weekends when they may not be expressing their milk. As the week progresses, some nursing mothers may find that there seems to be less milk to express—this is normal. A mother's milk supply will be maintained and increased if she nurses (or pumps) often (6 or more times a day during the week and more on weekends), gets adequate rest, and consumes a nutritionally adequate diet.

Although some planning and scheduling is required when combining nursing with working or school, continued nursing, to whatever degree, benefits both the mother and her infant.

Common Concerns

Flat or Inverted Nipples

By the time a mother is ready to start nursing, she may have had her nipples assessed to determine if they are normal, flat, or inverted. Flat or inverted nipples do not protrude properly when stimulated. Some infants may have difficulty grasping flat or inverted nipples. Some people advise that a woman can correct these conditions by wearing breast shells or milk cups (see page 51) in her bra towards the end of her pregnancy and, if still needed, between feedings during the postpartum period. However, one study suggests that the use of breast shells during pregnancy may reduce the chances of successful breastfeeding because of negative experiences that women have in using the shells (Alexander et al., 1992). If a woman has or thinks she has flat or inverted nipples, refer her to a person knowledgeable about lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) for assistance.

Sore Nipples

Some women may experience sore nipples during the immediate postpartum period, as they are learning and adapting to breastfeeding. However, this condition is usually relatively mild, i.e., it does not require medical intervention nor does it cause visible damage to the breast or the nipples. Generally, a mother should not feel tenderness or pain during nursing. Sore nipples beyond 2 weeks postpartum or soreness accompanied by visible damage to the breast or nipples may be caused by several factors which include the following:

- *Incorrect positioning of the infant on the breast.* If an infant is not positioned appropriately for nursing or his or her mouth is not attached to the breast with a good portion of the areola in the mouth, the nipple can become irritated. The infant's grasp on the nipple should not feel painful to the mother if the infant is properly attached to her breast. Note that if an infant is not in the stomach to stomach ("tummy to tummy") or chest to chest position, described on pages 42-43, he or she may pull on the nipple and not be suckling properly.
- *Inappropriate breast care practices.* If a mother is following breast care practices that are not recommended (see pages 52-53), she is more likely to develop sore nipples.
- *Inappropriate frequency and duration of nursing.* An infant who is allowed to become overly hungry may traumatize the nipple by suckling too vigorously. Also, if the mother's breasts are engorged from infrequent feedings, the infant may not be able to grasp the nipple and areola properly in the mouth and thus increase irritation to the nipple. See pages 47-49 regarding appropriate nursing frequency and duration.

Sore nipples (and cracked or bleeding nipples) can also be caused by poor suckling or a thrush infection (Saunders et al., 1988). A woman with a thrush infection on the nipples will usually complain of itching or burning nipples (Mohrbacher and Stock, 1991).

If a woman complains of sore nipples, the cause of the soreness needs to be determined in order to cure the condition and prevent it from recurring. A person knowledgeable about lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) can provide assessment, counseling, and followup services to women complaining of sore nipples.

Engorgement

Engorgement refers to a swelling of the breasts. Some engorgement, common in the first weeks of lactation, is a normal result of milk production beginning along with increased blood flow to the breasts. By the second or third week postpartum, this normal swelling decreases and the breasts will feel softer, even when the milk supply is plentiful (Mohrbacher and Stock, 1991).

Engorgement may also occur any time if milk is not removed from the breasts frequently. When such engorgement occurs, the breasts will feel full, hard, tender, and/or painful. It may be difficult to attach the infant to the breast because the nipple and areola become very taut and hard to grasp. Cases of severe engorgement are associated with abrupt changes in nursing frequency, such as when a mother skips several nursings in a day. *Common recommendations to relieve engorgement resulting from inadequate emptying of milk from the breasts include the following:*

- Apply moist heat (a washcloth soaked in warm water or going under a warm or hot shower) to the breasts for 10 minutes **before** a feeding to facilitate the let-down reflex;
- Express some milk to soften the areola and breast and allow the nipple to protrude easily;
- Massage the breasts to "push" milk from the edges of the breast toward the nipple; and
- Apply cold compresses to the breasts **after** feedings to reduce swelling and pain.

A mother is less likely to develop uncomfortable engorgement if her infant nurses frequently and effectively (Mohrbacher and Stock, 1991). A person knowledgeable about lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) can provide assessment, counseling, and followup services to women complaining of engorgement.

Plugged Milk Ducts

A plugged milk duct can occur when a milk duct becomes clogged with milk or cast off cells. A mother with a plugged milk duct will commonly complain of a localized tender area on her breast or a lump she can feel in her breast (but does not have fever or other flu-like symptoms). The following can lead to plugged milk ducts: severe engorgement, consistently nursing on one breast only, infrequent or skipped nursings, or pressure applied on the breast (e.g., by an overly tight bra or clothing or from certain sleeping positions).

To release a plugged milk duct, a mother can take these steps:

- Take a hot shower or apply warm, moist cloths to the area where the plug is located and the rest of the breast;
- Massage the breast from the plugged area down to the nipple before and during nursing;
- Nurse frequently (every $1^1/_2$ to 3 hours) and use different positions, as shown in figure 3, page 43;
- Position her infant's chin toward the plugged duct and empty the affected breast first; and
- Get plenty of rest.

Since mastitis can result if plugged milk ducts are not relieved, a mother should contact her health care provider if the plugged duct does not go away within 1 week or if she starts developing symptoms of mastitis (see below).

Mastitis

Mastitis is an inflammation of the breast caused by an infection of the breast. It can occur if a mother does not nurse frequently and effectively, and thus, often appears following engorgement or plugged ducts. This condition frequently occurs at times of stress or change in usual routine (e.g., guests are visiting, holiday time, return to work). Frequent and effective nursing (which empties the milk from the breasts regularly) can prevent most cases of mastitis from developing. References on lactation management can be consulted for other factors that increase the risk of developing mastitis.

A mother with mastitis may have any of the following symptoms: tenderness and/or redness of the breast, flu-like symptoms such as body aches, headache, nausea, fever, chills, malaise, or fatigue. A nursing mother complaining of any of these symptoms should contact or be referred to her health care provider immediately.
Antibiotics and rest will usually be prescribed to cure the infection. Antibiotics prescribed for this

condition are not contraindicated during breastfeeding. To prevent recurrence of mastitis, it is important that a woman take all of the prescription drug given to her even if her symptoms have disappeared before the medication is finished. Further, during treatment, it is recommended that women continue breastfeeding, use both breasts to nurse, and nurse frequently to remedy and prevent this condition (Lawrence, 1989; Riordan, 1983). If mastitis is not properly or completely treated, more serious conditions, such as sepsis (spread of infection throughout the body) or breast abscesses, may develop (Saunders et al., 1988).

Poor Suckling

An infant who does not appear to be correctly attached to the breast, chews on the nipple, or pushes the nipple out of his or her mouth may not be suckling effectively. Poor suckling may result from improperly positioning an infant, incorrect use of the tongue while nursing, nipple confusion (see page 50), and from other problems. An infant who suckles poorly may be nursing often but not effectively and thus not necessarily receiving sufficient milk from the breasts. Ultimately, poor suckling can result in a decrease in the mother's milk supply and an infant who is frustrated, not gaining weight adequately, and has a low urinary output and abnormally infrequent stools. If a mother complains that her infant has any of these symptoms, refer the infant to a health care provider. Additionally, a person knowledgeable about lactation management (e.g., physician, nurse, or nutritionist trained in this area, or a lactation consultant) can provide assessment, counseling, and followup services to correct suckling problems.

Use of Cigarettes, Alcohol and Other Drugs, and Certain Beverages During Lactation

This section provides guidelines and background information on the use of cigarettes, alcohol and other drugs, caffeine-containing products, and herbal teas during lactation. Refer to the Institute of Medicine's reports, **Nutrition During Lactation** (IOM, 1991) and **Nutrition During Pregnancy and Lactation: An Implementation Guide** (IOM, 1992), for diet and nutrition guidelines for nursing mothers.

Cigarettes

Nursing mothers should be actively discouraged from smoking, not only because smoking may interfere with the let-down reflex and reduce milk volume, but because of its harmful effects on the mother and her infant (IOM, 1991; Lawrence, 1989).

Effects of Cigarette Smoking on Infants

The infants of smoking mothers tend to have more frequent respiratory infections (Colley, 1974). Nicotine from cigarettes can enter an infant's system through breast milk. The nicotine content of the milk tends to increase with increased depth of inhalation and with an increased number of puffs per cigarette (Luck and Nau, 1985). However, no reports have been published associating nicotine from human milk with infant health problems (IOM, 1991). The Environmental Protection Agency (EPA, 1992) has concluded that second-hand smoke (cigarette smoke exhaled by smokers and given off by the burning ends of cigarettes) is a human lung carcinogen and that exposure to such smoke has these harmful effects on infants and children:

- Increases the risk of lower respiratory tract infections such as bronchitis and pneumonia;
- Increases the prevalence of fluid in the middle ear, a sign of chronic middle ear disease;
- Irritates the upper respiratory tract and is associated with a small but significant reduction in lung function;
- Increases the frequency of episodes and severity of symptoms in asthmatic children; and
- Is a risk factor for new cases of asthma in children who have not previously displayed symptoms.

Effects of Cigarette Smoking on the Mother

The U.S. Surgeon General (USPHS, 1979; 1985) has concluded that cigarette smoking increases a woman's risk of developing coronary heart disease, stroke, chronic lung disease, peptic ulcer, cancers (of the lung, larynx, oral cavity, esophagus, urinary bladder, and kidney), risk of dying prematurely in general, and is a major threat to the outcome of pregnancy and well-being of the newborn infant.

Smoking Cessation Refer nursing mothers who smoke and are having difficulty quitting to smoking cessation programs in your area. For advice on making such referrals, see the Food and Nutrition Service (FNS) publication "Providing Drug Abuse Information and Referrals in the WIC Program: A Local Agency Resource Manual," 1991 (FNS-276), and accompanying FNS audiovisual and other educational materials. If a nursing mother is unable to totally quit smoking, recommend that she (IOM, 1991):

- Cut down on the number of cigarettes smoked;
- Avoid smoking for $2^1/_2$ hours before nursing her infant (Luck and Nau, 1987);
- Avoid smoking during nursing;
- Avoid smoking in her infant's presence (nicotine, via cigarette smoke, can also enter an infant's system from the air); and
- Refrain from smoking until right after a feeding so that nicotine levels will have time to decrease before the next feeding.

Given the effects of second-hand smoke on children, advise mothers to also ask other smokers they know to avoid smoking around the infant or other children.

Alcohol

Contrary to popular belief, consumption of alcoholic beverages has not been shown to have any beneficial effects on lactation (IOM, 1991). Alcohol consumed by a mother can enter her infant's body through breast milk.

Effects of Alcohol on Mother and Infant Excessive alcohol intake is associated with failure to initiate the let-down reflex, high alcohol levels in milk, and lethargic infants (Cobo, 1973), as well as with adverse health consequences for the mother (IOM, 1991). The amount of alcohol which may impair the let-down reflex is more than about two alcoholic drinks (0.5 grams of alcohol per kilogram body weight) per day for the average woman (Cobo, 1973; Wagner and Fuchs, 1968). Two drinks are equivalent to about 3 ounces of liquor, two 12-ounce cans of beer, or 8 ounces of table wine. Also, a mother who drinks excessively may not be able to think and act normally and could accidently take actions which endanger her infant.

Recommendations on Alcohol Based on the above effects, discourage nursing mothers from drinking alcoholic beverages. Refer nursing mothers who drink excessively to alcohol assessment, treatment, and counseling services in your community. For advice on making such referrals, see the Food and Nutrition Service (FNS) publication "Providing Drug Abuse Information and Referrals in the WIC Program: A Local Agency Resource Manual," 1991 (FNS-276), and accompanying FNS audiovisual and other educational materials.

If a nursing mother will not or is unable to stop drinking alcohol, recommend that she limit her intake of alcoholic beverages as much as possible. The Dietary Guidelines for Americans (USDA and DHHS, 1990) recommend that if adults drink alcoholic beverages, they should consume them in moderation which, for a woman, is no more than one drink (12 ounces of regular beer, 5 ounces of wine, or $1^1/_2$ ounces of distilled spirits (80 proof)) per day.

Caffeine-Containing Products

Effects of Caffeine on Infants The equivalent of 1 to 2 cups of regular coffee daily is unlikely to have a harmful effect on the nursing infant (COD, 1989; Wilson, 1981; Wilson et al., 1985). A mother consuming excessive amounts of caffeine-containing products could excrete sufficient caffeine into her milk so that her infant would have symptoms including irritability and poor sleep patterns due to accumulation of the caffeine in the infant's body (COD, 1989; Lawrence, 1987).

Recommendations on Caffeine-Containing Products As recommended by the Institute of Medicine (IOM, 1991), discourage nursing mothers from consuming more than two 6-ounce cups daily of:

- Coffee;
- Decaffeinated coffee (there is still a small amount of caffeine in this product after decaffeination); and
- Other caffeine-containing beverages (tea, hot chocolate, some carbonated beverages such as colas).

Caffeine-containing medications (e.g., certain varieties of stimulants, pain relievers, cold remedies, and weight-control aids) should also be avoided. Nursing mothers on these medications should consult with their health care providers.

Herbal Teas

Concern has been expressed regarding the effects of some herbal teas consumed by nursing mothers on their infants. While many herbal teas are benign and serve as flavorful alternatives to caffeinated beverages, components in some herbal teas made with buckhorn bark, senna, chamomile, and a tea called "Mother's Milk Tea" (available in specialty food stores), may have undesirable effects on a breastfed infant when the tea is consumed by the mother (Abramowicz, 1979; Lawrence, 1987; Lawrence, 1989). Lawrence (1989) and Seigel (1976) provide information on the effects of different herbal tea ingredients on the body.

Other Drugs

Most nonprescription, prescription, and recreational or illicit drugs (e.g., marijuana, heroin, cocaine) used by a nursing mother are absorbed and excreted into her breast milk. However, not all drugs are excreted into breast milk at concentrations that are harmful to the infant. Some drugs which may not harm the breastfed infant may have a detrimental effect on the mother's ability to produce or secrete milk. The American Academy of Pediatrics Committee on Drugs publishes guidance regarding the transfer of drugs and medications, radiopharmaceuticals (radioactive drugs), and food and environmental agents into human milk and reported effects on lactation or on the infant when a mother ingests or is exposed to these substances (COD, 1994). Breastfeeding is contraindicated when drugs, medications, or other substances, taken by the mother and transmitted to the infant in the breast milk, may harm the infant.

Use of illicit drugs is contraindicated because of the potential for drug transfer through milk as well as hazards to the mother (IOM, 1991). Thus, the use of illicit drugs by nursing mothers should be actively discouraged and affected mothers, regardless of their mode of feeding, should be assisted to enter a rehabilitative program that makes provision for infants (see the FNS publication cited above under smoking and alcohol for more information).

Remind all nursing mothers to inform their health care providers that they are breastfeeding and inquire with the providers before taking any type of drug or vitamin/mineral supplements. Any decisions regarding drug use during lactation should be made between the mother and her health care provider.

Contraindications to Breastfeeding

In general, there are very few true contraindications to breastfeeding. Most women who desire to breastfeed can do so without problems. Breastfeeding may not be possible if a mother has certain serious infectious or other illnesses, alcoholism, an addiction to drugs such as heroin or cocaine, or an illness in which the medication or treatment prescribed is contraindicated during breastfeeding (e.g., when chemotherapeutic or radioactive drugs are prescribed during an illness).

The risk of transmitting the human immunodeficiency virus (HIV), the virus which causes acquired immune deficiency syndrome (AIDS), via breastfeeding by women who test seropositive for the virus during pregnancy has not been determined (IOM, 1991). However, the U.S. Centers for Disease Control and the Public Health Service recommend that women in the United States who test positive for the HIV antibody avoid breastfeeding in order to decrease the chances that the AIDS virus could be transmitted to the infant (Ammann, 1987; CDC, 1985; CDC, 1987).

If an infant has a metabolic disease which requires a specialized infant formula, breastfeeding may be contraindicated (e.g., in the case of infants with galactosemia, a rare medical condition). Infants with the metabolic disorder, phenylketonuria (PKU), can breastfeed on a limited basis as long as their diet is supplemented with a special low phenylalanine formula and they are carefully monitored (Lawrence, 1989; Mohrbacher and Stock, 1991).

If a woman questions whether breastfeeding is recommended during certain illnesses or medical or drug treatments, refer her to a qualified health care provider for advice.

Weaning the Breastfed Infant

The decision of when to begin weaning an infant from the breast is up to each mother and infant. However, the weaning process begins in part when solid foods are introduced and the infant begins nursing less frequently.

Approach to Gradual Weaning

Mothers who wish to wean their exclusively breastfed infants onto infant formula tend to experience less discomfort if the weaning process is gradual (e.g., over several weeks or longer). Gradual weaning also allows infants time to adjust to both the taste of infant formula and to drinking from a bottle or cup. Mothers can formally start weaning from the breast by replacing a nursing with a feeding of infant formula (or whole cow's milk if the infant is over 12 months old). The first nursing to replace could be the one the infant is least interested in or when the breasts do not feel full. Gradually over several days or even weeks, additional nursings can be eliminated. When down to one nursing per day, the infant can be breastfed every other day. Some mothers and infants may still want to nurse once in a while just for comfort or to relax.

Weaning to a Bottle or a Cup

Mothers who wish to discontinue nursing can wean their infants, over 6 months old, to infant formula in a bottle and/or cup, depending on the infant's developmental ability. Some older infants may need to be weaned to a bottle because they are not developmentally ready to drink significant quantities of liquid from a cup. It is advisable to wean infants entirely off the bottle and onto a cup by about 12 months old (see page 105 for more information). Weaning to infant formula may be easier if powdered formula is used—this type of formula allows the caregiver to prepare a limited number of bottles, if necessary, without wasting formula.

Teething and Biting

Teething and biting are not reasons to wean an infant from the breast. References such as Huggins (1990), Mohrbacher and Stock (1991), and Lauwers and Woessner (1989) include useful tips on coping with teething and biting in nursing infants. See pages 116-117 for tips on soothing an infant who is teething.

Reducing Breast Discomfort

As a mother gradually decreases the number of nursings per day, her breasts will produce less milk. However, if she weans abruptly, her breasts will have less time to adapt and may become engorged with milk. A mother can relieve discomfort from full breasts by expressing some milk without emptying the breast (if a breast is emptied, milk production will be stimulated).

Relactation

A mother who has mostly or totally weaned, and then decides she wants to resume nursing because her infant is intolerant to infant formula or for other reasons, can consult with a person trained in lactation management for assistance with relactation (relactation is rebuilding a birth mother's milk supply after it has been reduced or dried up (Mohrbacher and Stock, 1991)).

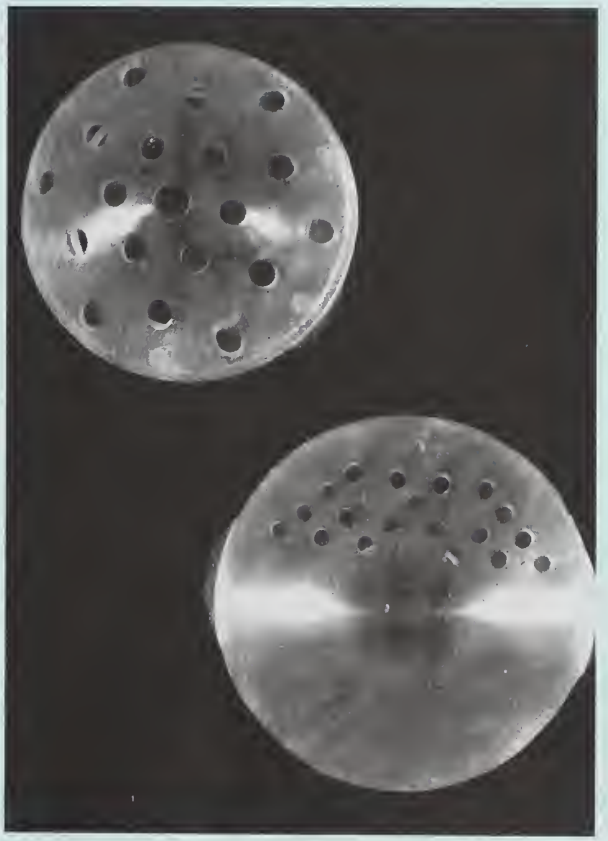
Figure 6: Illustrations of Aids and Devices for Breastfeeding

Nursing Bra (Brassiere)—Example of one type of nursing bra.

Credits for the photographs in figure 6 are found on page 188.

Figure 6: Illustrations of Aids and Devices for Breastfeeding, continued

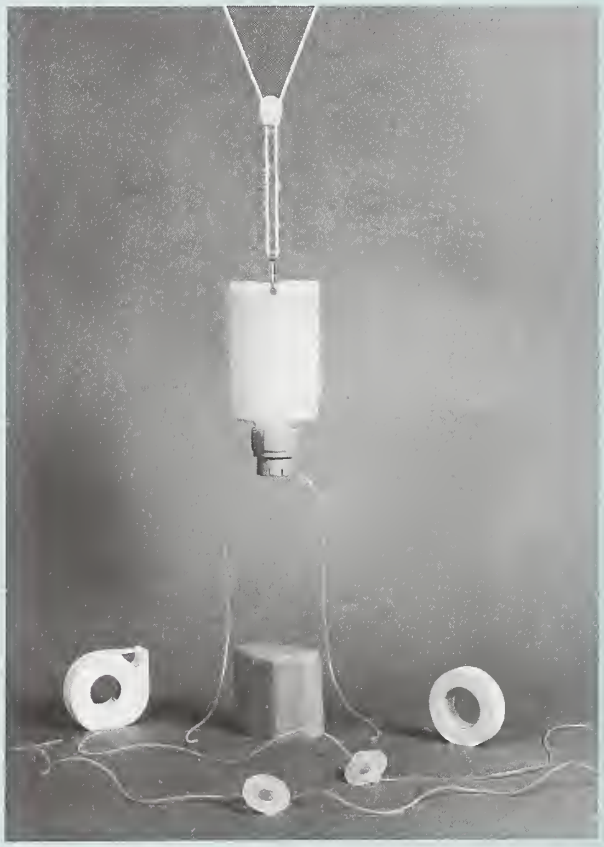
Nursing Pad—Example of one type of commercially available nursing pad.



Breast Shell (or Milk Cup)—Examples of two types of breast shells.

Figure 6: Illustrations of Aids and Devices for Breastfeeding, continued

Nursing Supplementer (Feeding Tube Device)—Example of one type of nursing supplementer in use by a mother



Nursing Supplementer (Feeding Tube Device)—Example of another type of nursing supplementer.

Figure 6: Illustrations of Aids and Devices for Breastfeeding, continued

Nipple Shield—Example of a nipple shield from two different angles.

References

Abramowicz, M. Toxic reactions to plant products sold in health food stores. **Medical Letter on Drugs and Therapeutics** 21 (7): 1-3, 1979.

Alexander, J.M., Grant, A.M., and Campbell, M.J. Randomised controlled trial of breast shells and Hoffman's exercises for inverted and non-protractile nipples. **BMJ** 304: 1030-1032, 1992.

Ammann, A.J. The immunology of pediatric AIDS. In: U.S. Department of Health and Human Services: **Report of the Surgeon General's Workshop on Children with HIV Infection and their Families.** Washington, DC: U.S. Government Printing Office, 1987.

Barger, J. and Bull, P. A comparison of the bacterial composition of breast milk stored at room temperature and stored in the refrigerator. **Int. J. Childbirth Educ.** 2:29-30, 1987.

Blanc, B. Biochemical aspects of human milk—comparison with bovine milk. **World Rev. Nutr. Diet.** 36: 1-89, 1981.

Borch-Johnsen, K., Joner, G., Mandrup-Poulsen, T., Christy, M., Zachau-Christiansen, B., Kastrup, K., and Nerup, J. Relationship between breast-feeding and incidence of insulin-dependent diabetes mellitis. A hypothesis. **Lancet** 2: 1083-1086, 1984.

Brown, K.H., Aktar, N.A., Robertson, A.D., and Ahmed, M.G. Lactational capacity of marginally nourished mothers: relationships between maternal nutritional status and quantity and proximate composition of milk. **Pediatrics** 78: 909-919, 1986.

Bullen, J.J., Rogers, H.J., and Griffiths, E. Role of iron in bacterial infection. **Curr. Top. Microbiol. Immunol.** 80: 1-35, 1978.

Burgio, G.R., Lanzavecchia, A., Plebani, A., Jayakar, S., and Ugazio, A.G. Ontogeny of secretory immunity: levels of secretory IgA and natural antibodies in saliva. **Pediatr. Res.** 14: 1111-1114, 1980.

Butte, N.F., Garza, C, Smith, E.O., and Nichols, B.L. Human milk intake and growth in exclusively breast-fed infants. **J. Pediatr.** 104: 187-195, 1984.

Byers, T., Graham, S., Rzepka, T., and Marshall, J. Lactation and breast cancer: evidence for a negative association in premenopausal women. **Am. J. Epidemiol.** 121: 664-674, 1985.

CDC (Centers for Disease Control). Recommendations for assisting in the prevention of perinatal transmission of human T- lymphotropic virus Type III/lymphadenopathy-associated virus and Acquired Immunodeficiency Syndrome. **MMWR** 34: 721, 1985.

CDC (Centers for Disease Control). Public Health Service guidelines for counseling and antibody testing to prevent HIV infection and AIDS. **MMWR** 36: 509, 1987.

Chiba, Y., Minagawa, T., Mito, K., Nakane, A., Suga, K., Honjo, T., and Nkao, T. Effect of breast feeding on responses of systemic interferon and virus-specific lymphocyte transformation in infants with respiratory syncytial virus infection. **J. Med. Virol.** 21: 7-14, 1987.

Chipman, D.M. and Sharon, N. Mechanism of lysozyme action. **Science** 165: 454-465, 1969.

Cobo, E. Effect of different doses of ethanol on the milk-ejecting reflex in lactating women. **Am. J. Obstet. Gynecol.** 115:817-821, 1973.

COD (Committee on Drugs), American Academy of Pediatrics. The transfer of drugs and other chemicals into human milk. **Pediatrics** 93: 137-150, 1994.

Colley, J. and Corkhill, R. Influence of passive smoking and parental phlegm on pneumonia and bronchitis in early childhood. **Lancet** 2: 1031, 1974.

CON (Committee on Nutrition), American Academy of Pediatrics. Statement on cholesterol. **Pediatrics** 90: 469-473, 1992.

Cunningham, A.S. Breast-feeding and morbidity in industrialized countries: an update. In: Jelliffe, D.B. and Jelliffe, E.F.P. (eds.). **Advances in International Maternal and Child Health,** Vol. 1. Oxford: Oxford University Press, 1981.

Cushing, A.H. and Anderson, L. Diarrhea in breast-fed and non-breast-fed infants. **Pediatrics** 70: 921-925, 1982.

Dallman, P.R. Iron deficiency in the weanling: a nutritional problem on the way to resolution. **Acta Paediatr. Scand.** Suppl. 323: 59-67, 1986.

Davies, D.P. and Evans, T. The starved but contented breast-fed baby. **Arch Dis Child** 53: 163, 1978.

Davis, M.K., Savitz, D.A., and Graubard, B.I. Infant feeding and childhood cancer. **Lancet** 2: 365-368, 1988.

de Carvalho, M., Robertson, S., Merkatz, R., and Klaus, M. Milk intake and frequency of feeding in breast fed infants. **Early Hum. Dev.** 7: 155-163, 1982.

Downham, M.A.P.S., Scott, R., Sims, D.G., Webb, J.K.G., and Gardner, P.S. Breast-feeding protects against respiratory syncytial virus infections. **Br. Med. J.** 2: 274-276, 1976.

Dusdieker, L.B., Booth, B.M., Stumbo, P.J., and Eichenberger, J.M. Effect of supplemental fluids on human milk production. **J. Pediatr.** 106: 207-211, 1985.

EPA (Environmental Protection Agency). **Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders.** Washington, DC: U.S. Environmental Protection Agency, EPA/600/6-90/006F, 1992.

Furmanski, P., Zhen-Pu, L., Fortuna, M.B., Swamy, C.V.B., and Ramachandra Das, M. Multiple molecular forms of human lactoferrin: identification of a class of lactoferrins that possess ribonuclease activity and lack iron-binding capacity. **J. Exp. Med.** 170: 415-429, 1989.

Goldman, A.S. and Goldblum, R.M. Immunologic system in human milk: characteristics and effects. In: Lebenthal, E. (ed.). **Textbook of Gastroenterology and Nutrition in Early Infancy,** 2nd ed. New York, NY: Raven Press, 1989.

_____. Human milk: immunologic-nutritional relationships. **Ann. N.Y. Acad. Sci.** 587: 236-245, 1990.

Goldman, A.S., Thorpe, L.W., Goldblum, R.M., and Hanson, L.A. Anti-inflammatory properties of human milk. **Acta Paediatr. Scand.** 75: 689-695, 1986.

Goldman, A.S., Goldblum, R.M., and Hanson, L.A. Anti-inflammatory systems in human milk. In: Bendich, A., Phillips, M., and Tengerdy, R.P. (eds). **Antioxidant Nutrients and Immune Functions.** New York, NY Plenum Press, 1990.

György, P. A hitherto unrecognized biochemical difference between human milk and cow's milk. **Pediatrics** 11: 98, 1953.

György, P., Jeanloz, R.W., von Nicolai, H., and Zilliken, F. Undialyzable growth factors for *Lactobacillus bifidus var. Pennsylvanicus:* protective effect of sialic acid bound to glycoproteins and oligosaccharides against bacterials degradation. **Eur. J. Biochem.** 43: 29-33, 1974.

Hanson, L.A., Söderström, T., Brinton, C., Carlsson, B., Larsson, P., Mellander, L., and Eden, C.S. Neonatal colonization with *Escherichia coli* and the ontogeny of the antibody response. **Prog. Allergy** 40-52, 1983.

Huggins, K. **The Nursing Mother's Companion.** Boston, MA: The Harvard Common Press, 1990.

IOM (Institute of Medicine). **Nutrition During Lactation. Report of the Subcommittee on Nutrition During Lactation, Food and Nutrition Board, Institute of Medicine.** Washington, DC: National Academy Press, 1991.

_____. **Nutrition During Pregnancy and Lactation. An Implementation Guide. Report of the Subcommittee for a Clinical Application Guide, Food and Nutrition Board, Institute of Medicine.** Washington, DC: National Academy Press, 1992.

Jensen, R.G. **The Lipids of Human Milk.** Boca Raton, FL: CRC Press, 1989.

Jolley, S. **Breastfeeding Triage Tool.** Seattle, WA: Seattle-King County Department of Health, 1988.

Kennedy, K.I., Rivera, R., and McNeilly, A.S. Consensus statement on the use of breastfeeding as a family planning method. **Contraception** 39: 477-491, 1989.

Kramer, M.S. Does breast feeding help protect against atopic disease? Biology, methodology, and a golden jubilee of controversy. **J. Pediatr.** 112: 181-190, 1988.

Kvåle, G. and Heuch, I. Lactation and cancer risk: is there a relation specific to breast cancer? **J. Epidemiol. Commun. Health** 42: 30-37, 1987.

Lauwers, J. and Woessner, C. **Counseling the Nursing Mother: A Reference Handbook for Health Care Providers and Lay Counselors.** 2nd ed. Garden City Park, NY: Avery Publishing Group, Inc., 1989.

Lawrence, R.A. Medications and breast milk. **Childbirth Educator** Spring 1987, pp. 47-56.

_____. **Breastfeeding: A Guide for the Medical Profession.** 3rd ed. St. Louis, MO: The C.V. Mosby Company, 1989.

Layde, P.M., Webster, L.A., Baughman, A.L., Wingo, P.A., Rubin, G.L., and Ory, H.W. The independent associations of parity, age at first full term pregnancy, and duration of breastfeeding with the risk of breast cancer. Cancer and Steroid Hormone Study Group. **J. Clin. Epidemiol.** 42:963-973, 1989.

Lelong, M., Alison, F., and Vinceneux, J. Secretion lactee humaine et alimentation hydrique. **Lait** 29: 237-246, 1949.

L'Esperance, C. and Frantz, K. Time limitation for early breastfeeding. **JOGN Nurs** 95: 75-79, 1985.

London, S.J., Colditz, G.A., Stampfer, M.J., Willett, W.C., Rosner, B.A., Corsano, K., and Speizer, F.E. Lactation and risk of breast cancer in a cohort of U.S. women. **Am. J. Epidemiol.** 132: 17-26, 1990.

Luck, W. and Nau, H. Nicotine and cotinine concentrations in serum and urine of infants exposed via passive smoking or milk from smoking mothers. **J. Pediatr.** 107: 816-820, 1985.

_____. Nicotine and cotinine concentrations in the milk of smoking mothers: influence of cigarette consumption and diurnal variation. **Eur. J. Pediatr.** 146: 21-26, 1987.

Mayer, E.J., Hamman, R.F., Gay, E.C., Lezotte, D.C., Savitz, D.A., and Klingensmith, G.J. Reduced risk of IDDM among breast-fed children: the Colorado IDDM Registry. **Diabetes** 37: 1625-1632, 1988.

McTiernan, A. and Thomas, D.B. Evidence for a protective effect of lactation on risk of breast cancer in young women: results from a case-control study. **J. Epidemiol.** 124: 353-358, 1986.

Mohrbacher, N. and Stock, J. **The Breastfeeding Answer Book.** Franklin Park, IL: La Leche League International, 1991.

Motil, K.J. Breast-feeding: public health and clinical overview. In: Grand, R.J., Sutphen, J.L., and Dietz, W.H. **Pediatric Nutrition: Theory and Practice.** Boston, MA: Butterworth Publishers, 1987.

Myers, M.G., Fomon, S.J., Koontz, F.P., McGuinness, G.A., Lachenbruch, P.A., and Hollingshead, R. Respiratory and gastrointestinal illnesses in breast and formula-fed infants. **Am. J. Dis. Child.** 138: 629-632, 1984.

Olsen, A. Om diegivningsevnen under torst og under extradrikning. **Ugeskr. Laegl** 103: 897-905, 1941.

Palti, H., Mansbach, I., Pridan, H., Adler, B., and Palti, Z. Episodes of illness in breast-fed and bottle-fed infants in Jerusalem. **Isr. J. Med. Sci.** 20: 395-399, 1984.

Pérez, A., Labbok, M.H., and Queenan, J.T. Clinical study of the lactational amenorrhea method of family planning. **Lancet** 339: 968-970, 1992.

Prentice, A., Prentice, A.M., and Whitehead, R.G. Breast-milk fat concentrations of rural African women. 2. Long-term variations within a community. **Br. J. Nutr.** 45: 495-503, 1981.

Prentice, A.M., Lamb, W.H., Prentice, A., and Coward, W.A. The effect of water abstention on milk synthesis in lactating women. **Clin. Sci.** 66: 291-298, 1984.

Pullan, C.R., Toms, G.L., Matin, A.J., Gardner, P.S., Webb, J.K.G., and Appleton, D.R. Breast-feeding and respiratory syncytial virus infection. **Br. J. Med.** 281: 1034-1036, 1980.

Riordan, J. **A Practical Guide to Breastfeeding.** St. Louis, MO: The C. V. Mosby Company, 1983.

Riordan, J. and Auerbach, K.G. **Breastfeeding and Human Lactation.** Boston, MA: Jones and Bartlett Publishers, 1993.

Saarinen, U.M. Prolonged breast feeding as prophylaxis for recurrent otitis media. **Acta Paediatr. Scand.** 71: 567-571, 1982.

Sanders, T.H.B., Ellis, T.R., and Dickerson, J.W.T. Studies of vegans: the fatty composition of plasma choline-phosphoglycerides, erythrocytes, adipose tissue, breastmilk and some indicators of susceptibility to ischemic heart disease in vegans and omnivore controls. **Am. J. Clin. Nutr.** 31: 805, 1978.

Saunders, S., Carroll, J.M., and Johnson, C.E. **Breastfeeding: A Problem-Solving Manual.** 2nd ed. Amityville, NY: Essential Medical Information Systems, Inc., 1988.

Schaefer, O. Otitis media and bottle-feeding. An epidemiological study of infant feeding habits and incidence of recurrent and chronic middle ear disease in Canadian Eskimos. **Can. J. Public Health** 62: 478-489, 1971.

Seigel, R.K. Herbal intoxication: psychoactive effects from herbal cigarettes, tea and capsules. **JAMA** 236:473, 1976.

Sosa, R. and Barness, L. Bacterial growth in refrigerated human milk. **Am. J. Dis. Child.** 141:111-112, 1987.

Spisak, S. and Gross, S.S. **Second Followup Report: The Surgeon General's Workshop on Breastfeeding and Human Lactation.** Washington, DC: National Center for Education in Maternal and Child Health, 1991.

Stephens, S., Dolby, J.M., Montreuil, J., and Spik, G. Differences in inhibition of the growth of commensal and enteropathogenic strains of *Escherichia coli* by lactotransferrin and secretory immunoglobulin A isolated from human milk. **Immunology** 41: 597-603, 1980.

Tao, S.C., Yu, M.C., Ross, R.K., and Xiu, K.W. Risk factors for breast cancer in Chinese women of Beijing. **Int. J. Cancer** 42: 495-498, 1988.

USDA (U.S. Department of Agriculture). **WIC Breastfeeding Promotion Study and Demonstration, Phase IV Report, Volumes I and II.** Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service, 1990.

USDA (U.S. Department of Agriculture) and DHHS (U.S. Department of Health and Human Services). **Nutrition and Your Health: Dietary Guidelines for Americans.** Home and Garden Bulletin No. 232. Washington, DC: U.S. Government Printing Office, 1990.

U.S.P.H.S. (U.S. Public Health Service). **Smoking and Health. A Report of the Surgeon General. Department of Health, Education, and Welfare, Public Health Service, Office of the Assistant Secretary for Health, Office of Smoking and Health.** DHEW Publication No. (PHS) 79-50066, 1979.

U.S.P.H.S. (U.S. Public Health Service). **The Health Consequences of Smoking For Women. A Report of the Surgeon General. Department of Health and Human Services, Public Health Service, Office of the Assistant Secretary for Health, Office on Smoking and Health.** Washington, DC: Government Printing Office, 1985.

Wagner, G. and Fuchs, A.R. Effect of ethanol on uterine activity during suckling in post-partum women. **Acta Endocrinol.** 58: 133-141, 1968.

Whitley, N. Preparation for breastfeeding: A one-year follow-up of 34 nursing mothers. **J.O.G.N. Nurs.** 73: 44-48, 1974.

Wilson, J.T. Milk/plasma ratios and contraindicated drugs. In: Wilson, J.T. (ed). **Drugs in Breast Milk.** Balgowlah: ADIS Press, 1981.

Wilson, J.T., Brown, R.D., Hinson, J.L., and Dailey, J.W. Pharmacokinetic pitfalls in the estimation of the breast milk/plasma ratio for drugs. **Ann. Rev. Pharmacol. Toxicol.** 25: 667-689, 1985.

Yamauchi, Y. and Yamanouchi, I. Breast-feeding frequency during the first 24 hours after birth in full-term neonates. **Pediatrics** 86: 171-175, 1990.

Yuan, J.M., Yu, M.C., Ross, R.K., Gao, Y.T., and Henderson, B.E. Risk factors for breast cancer in Chinese women in Shanghai. **Cancer Res.** 48: 1949-1953, 1988.

Formula Feeding

This chapter reviews commonly used types of commercial infant formula, other milks, recommended amounts to feed formula-fed infants in the first year, tips on bottle feeding, guidelines on the selection, preparation, and storage of infant formula, traveling with formula, warming of bottles, and on infant formula use when there is limited access to common kitchen appliances. Counseling points related to the information presented in this chapter are found in chapter 7, pages 133-136.

This chapter does not address the formula needs and feeding protocols for premature and low-birth-weight infants. Since nutritional management of these infants may be complicated by treatment for coexisting medical conditions, consult with and follow the recommendations of the infant's health care provider in counseling caregivers of these infants.

Types of Commercial Infant Formulas

A variety of commercial infant formulas are available for infants who are partially or not breastfed. These include milk-based infant formulas (iron-fortified and low-iron formula), soy-based infant formulas, and other formulas designed to meet the nutritional needs of infants with special dietary needs.

Milk-Based Infant Formula

The most common types of formula consumed by infants today are made from a cow's milk base. These formulas are made from nonfat cow's milk to which carbohydrate (usually lactose), vegetable oils, and vitamins and minerals are added. Casein is the predominant protein in cow's milk. Since the primary protein in human milk is whey protein, rather than casein, some milk-based formulas have been altered to contain more whey. Despite that alteration, the protein in formula is still significantly different from that in human milk because human milk whey has a different amino acid and protein composition compared to cow's milk whey. In these formulas, about 9 percent of the kilocalories are provided by protein, 48-50 percent by fat, and 40-45 percent by carbohydrate. These formulas are lower in fat, and higher in carbohydrate, protein, and minerals than human milk.

Standard milk-based infant formulas are often categorized based on their iron content; i.e., iron-fortified and low-iron milk-based infant formulas.

Iron-Fortified Infant Formula

For infants who are not breastfed or are partially breastfed, iron-fortified infant formula is the most appropriate alternative to breast milk or when a supplement to breastfeeding is needed. The American Academy of Pediatrics, Committee on Nutrition sees no role for the use of low-iron formula in infant feeding and recommends that iron-fortified formula be used for all formula-fed infants (CON, 1989; 1992).

Use of an iron-fortified infant formula ensures that formula-fed infants receive an adequate amount of iron, an important nutrient during the first year. Standard iron-fortified infant formulas are fortified with approximately 9.6 to 12.0 milligrams of iron, in the form of ferrous sulfate, per quart. Research shows that providing iron-fortified infant formula and cereal for the first 12 months of life, as done in the WIC and CSF Programs, has been successful in reducing iron deficiency (Miller et al., 1985; Vazquez-Seoane et al., 1985; Yip et al., 1987a; 1987b).

Low-Iron Infant Formula

There are very few medical conditions for which low-iron infant formulas are indicated. These medical conditions include those in which the body has or may develop an overload of iron and a high level of dietary iron is contraindicated. Examples of these conditions include hemochromatosis, hemosiderosis, neonatal iron storage disease, and conditions in which an infant requires a hypertransfusion regimen (in which transfusions are given on a regular basis) for treatment of an underlying hemologic disorder. Some caregivers request low-iron infant formula for their infants because they believe that the iron in the formula causes gastrointestinal problems, such as constipation, diarrhea, or vomiting. However, studies have demonstrated that gastrointestinal problems are

no more frequent in infants consuming iron-fortified than low-iron formula (CON, 1989; Nelson et al., 1988; Oski, 1980).

The most commonly used milk-based formulas are also available with a reduced iron content. These low-iron infant formulas contain approximately 1.0 to 1.4 milligrams of iron per quart of formula.

As noted above, for the partially or nonbreastfed infant, iron-fortified infant formula is the formula of choice to assure that an infant's iron needs are met.

Soy-Based Infant Formula

Soy-based infant formulas were originally developed for infants who could not tolerate formula made from cow's milk. These formulas contain soy protein isolate made from soybean solids as the protein source, vegetable oils as the fat source, added carbohydrate (usually sucrose and/or corn syrup solids), and vitamins and minerals. Soy-based infant formulas are fortified with the essential amino acid, methionine, which is found in very low quantities in soybeans. In these formulas, about 12 percent of the kilocalories are provided by protein, 45 to 48 percent by fat, and 34 to 40 percent by carbohydrate. All soy-based infant formulas are fortified with similar amounts of iron as standard milk-based iron-fortified infant formulas. Currently, there are no commercial low-iron soy-based infant formulas available.

Physicians usually prescribe soy-based infant formulas for infants who are allergic or sensitive to cow's milk protein or lactose, infants with galactosemia, or as a temporary feeding following diarrhea until the enzyme lactase in the intestines is restored (CON, 1983). Soy-based infant formulas have also been prescribed for strict vegetarian families who prefer not to feed any animal products to their infants. Some infants who are hypersensitive (allergic) to milk-based infant formulas may also have a reaction to the proteins in soy-based infant formulas.

For more information on soy-based infant formulas and indications for their use, refer to "Infant Formulas, Exempt Infant Formulas, and Medical Foods Eligible for Use in WIC," Nutrition and Technical Services Division, Food and Nutrition Service, U.S. Department of Agriculture (FNS-268, 1990).

Other Infant Formulas

There are many varieties of specially designed infant formulas developed for infants with special medical problems. For information on the various types of infant formula, refer to the publication, "Infant Formulas, Exempt Infant Formulas, and Medical Foods Eligible for Use in WIC," Nutrition and Technical Services Division, Food and Nutrition Service, U.S. Department of Agriculture (FNS-268, 1990). For the most up-to-date information on infant formula composition and new products, refer to pharmaceutical company product information materials.

Other Milks and Other Products

This section provides information on different milk and other products which are not appropriate as substitutes for commercial infant formula for infants, less than 12 months old, in the WIC and CSF Programs.

Whole Cow's Milk

The American Academy of Pediatrics, Committee on Nutrition, recommends that whole cow's milk not be used to feed infants during the first year of life (CON, 1992a). Breast milk or iron-fortified infant formula are recommended instead of cow's milk for a number of nutritional and medical reasons.

Whole cow's milk is not recommended for infants for the following reasons:

- **Inappropriate nutrient content**— Research indicates that it is difficult for infants to consume a balanced diet, with adequate nutrients, when whole cow's milk replaces breast milk or iron-fortified infant formula (Montalto et al., 1985; Montalto and Benson, 1986; Martinez et al., 1985; Shank et al., 1987). Infants fed whole cow's milk have

low intakes of iron, linoleic acid (an essential fatty acid), and vitamin E and excessive intakes of sodium, potassium, chloride, and protein (CON, 1992a). These nutrient intakes are not optimal and may alter an infant's nutritional status, with the most dramatic effect on iron status (CON, 1992a). Infants over 6 months old require good sources of iron in their diets; there is very little iron in whole cow's milk. The composition of whole cow's milk (i.e., high calcium, high phosphorus, and low vitamin C) may inhibit an infant's ability to absorb iron from different solid foods, including iron-fortified infant cereals (Barton et al., 1983).

- **Causes microscopic gastrointestinal bleeding and blood loss**—Whole cow's milk has been shown to cause microscopic bleeding and blood loss from an infant's immature gastrointestinal tract when fed to infants in the first 6 months of life (Fomon et al., 1981) and the second 6 months of life (Wilson, 1984; Woodruff, 1983; Zeigler, 1990). This bleeding promotes the development of iron deficiency anemia. Studies show that iron deficiency in early childhood may lead to long-term changes in learning and behavior that may not be reversed even with iron supplementation sufficient to correct iron-deficiency anemia (CON, 1992a; Walter et al., 1988; Lozoff et al., 1987; Pollitt et al., 1988; Dobbing, 1990).
- **Stress on the kidneys**—Cow's milk is difficult for a young infant's immature kidneys to process because of its concentrated amount of protein, sodium, potassium, and chloride and resulting high renal solute load (see page 17 on renal solute load). The renal solute load of infants fed whole cow's milk is two to three times higher than that of formula-fed infants (Martinez et al., 1985). In the past, researchers thought that, by 6 months old, an infant's kidneys are able to process those higher concentrations of nutrients, but evidence now suggests that older infants may have a problem with the load of these nutrients on the kidneys (Winick, 1989; Zeigler, 1990). Also, in very hot climates or when an infant requires extra water (e.g., with fever or diarrhea), consumption of cow's milk may place extra stress on an infant's kidneys because it is too concentrated and does not contain sufficient water (Fomon, 1987; Fomon et al., 1990). Consumption of cow's milk could be dangerous for infants with symptoms or medical conditions associated with dehydration (e.g., diarrhea, vomiting, and fever) (Zeigler, 1990).
- **Hypersensitivity (allergic) reactions**—Cow's milk contains proteins which may cause hypersensitivity (allergic) reactions in the young infant due to its immature gastrointestinal tract.

Given these concerns about cow's milk, breast milk and commercial iron-fortified infant formulas (for those not or partially breastfed) are the recommended choices to use in meeting an infant's nutritional needs. Encourage caregivers to breastfeed or keep their infants on iron-fortified infant formula until 12 months old.

Low-Fat or Skim Cow's Milk

Pediatric nutrition authorities agree that skim milk (fresh liquid, reconstituted nonfat dry milk powder, or evaporated skimmed milk) or low-fat milk ($^1/_2$, 1, or 2 percent low-fat milk) should not be fed to infants (CON, 1993). These milks contain insufficient quantities of fat (including linoleic acid), iron, vitamin E, and vitamin C and excessive protein, sodium, potassium, and chloride. The amount of protein and minerals in low-fat and skim milk is even higher than in whole cow's milk; these milks place a strain on an infant's kidneys as does whole cow's milk. *Studies indicate that when infants are fed low-fat milk products, such as skim milk, in the first year, they* (CON, 1992b; Fomon, 1987; Fomon et al., 1977; Fomon et al., 1979; Ryan et al., 1987):

- Do not consume sufficient kilocalories to meet their energy needs;
- Gain weight at a slower rate than infants on commercial infant formula; and
- Tend to increase their intake of the lower fat milk to compensate for the lower number of kilocalories.

Fat, as found in sufficient amounts in breast milk and infant formula, is needed to meet an infant's energy needs, for growth, and for proper development of the nervous system. Increased

publicity of the association between high-fat diets and heart disease has lead some caregivers to believe that they should feed their infants skim or low-fat milk to prevent obesity or atherosclerosis later in life. However, based on current scientific research, the feeding of skim or low-fat milk to infants and children up to age 2, in an attempt to prevent heart disease from developing later in life, is not considered appropriate (CON, 1985; CON, 1986; Howard and Winter, 1984). According to the American Academy of Pediatrics, skim or low-fat milk is not recommended in the first 2 years of life because of the high protein and electrolyte content and low calorie density of these milks (CON, 1992b).

Evaporated Cow's Milk

Homemade formulas made from evaporated milk are not recommended in the first 12 months of life (CON, 1992a). Evaporated whole milk is whole cow's milk from which approximately 60 percent of the water has been removed. This milk is fortified with vitamin D but remains low in the same nutrients as whole cow's milk, and low in folate if the milk is boiled. Evaporated milk can also be made from skim cow's milk. Before the development of commercial infant formulas, evaporated whole milk was used to make a homemade infant formula which was thought to be easier for an infant's kidneys and digestive system to handle than plain whole cow's milk. However, the disadvantages of evaporated milk formulas are now considered similar to those of whole cow's milk.

Sweetened Condensed Milk

Sweetened condensed milk is not an appropriate food or beverage for infants. This milk product has a high sugar concentration and similar disadvantages as whole cow's milk. This milk product is made by adding sugar to whole cow's milk and then evaporating water from the milk. When undiluted, this milk contains seven times the carbohydrate content of evaporated whole milk.

Goat's Milk

Goat's milk is not recommended for infants. Goat's milk contains inadequate quantities of iron, folate, vitamins C and D, thiamin, niacin, vitamin B_6, and pantothenic acid to meet an infant's nutritional needs. Some brands of goat milk are fortified with vitamin D and folate, but other brands may not be fortified. This milk also has a higher renal solute load compared to cow's milk and can place stress on an infant's kidneys. This milk has been found to cause a dangerous condition called metabolic acidosis when fed to infants in the first month of life (Harrison et al., 1979).

Imitation Milks

Substitute or imitation milks lack appropriate amounts of kilocalories, protein, and other key nutrients, making them not suitable for feeding to infants. Use of these milks can be dangerous to an infant's health. Examples of imitation milks which have been fed to infants include nondairy creamer; a homemade beverage made of barley water, whole cow's milk, water, and corn syrup; and soy beverages (also called soy drinks or soy milks) (see page 118 for more information on soy beverages).

Recommended Amounts of Formula In the First Year

The amount of formula needed by an infant over a 24-hour period will vary depending on the infant's age, size, level of activity, metabolic rate, medical conditions, and whether the infant is receiving breast milk and/or food as well. Infants have the ability to regulate their food intake relative to their nutritional needs. In doing so, they express signs of hunger and satiety and expect their caregiver to respond to these cues. Thus, in general and unless medically indicated otherwise, infants should be fed on demand, i.e., fed when they indicate their hunger, and not forced to follow a strict feeding schedule, nor to finish a bottle when no longer hungry. Infants placed on strict feeding schedules in the early months of life stand a greater chance of either being overfed or underfed.

Hunger and Satiety Cues

Infants, especially newborns, may be erratic as to when and how often they want to eat. Thus, encourage caregivers to watch for and respond appropriately to the infant's cues of hunger and satiety or fullness. See page 47 for signs of hunger. Since it is normal for infants to have fussy times, an infant may cry and just want to be held or to suck and may not actually be hungry. If you perceive that a caregiver is troubled by or not coping with an infant's fussiness or crying, refer him or her to a health care provider for further assessment and assistance. A caregiver who is not sure whether her infant is hungry can first attempt to soothe him or her by holding, rocking, and playing before resorting to feeding.

Signals that an infant is full and satisfied include the following:

- lessened interest in taking more from the bottle (e.g., the infant turns away from bottle, seals his or her lips, or spits out the nipple); and
- more interest in other things going on around the infant.

Feeding Frequency and Amount

Newborn formula-fed infants are generally fed formula as often as exclusively breastfed infants are nursed. That is, newborn infants may initially feed 8 to 12 times per day at intervals of every 1 $^{1}/_{2}$ to 3 hours; they may consume from 2 to 3 ounces at a feeding. These young infants need to be fed small amounts of formula often throughout the day and night because their stomachs cannot hold a large quantity.

From birth to age 6 months, infants grow rapidly and will gradually increase the amounts of formula they can consume at each feeding, the time between each feeding, and the total amount of formula consumed in 24 hours. For example, an infant who consumes 2 ounces of infant formula every 2 hours at age 1 month (for a total of 24 ounces) may consume 5 ounces of formula every 4 hours at age 4 months (for a total of 30 ounces), or 8 ounces of formula five times a day at 6 months (for a total of 40 ounces). Between 6 and 12 months old, most infants begin consuming more solid foods, and over time decrease both the number of formula feedings (to about 4 per day) and the total amount of formula (6 to 8 ounces at each feeding for a total of 24 to 32 ounces per day). The partially breastfed infant would consume less infant formula than given in these examples, depending on the frequency of nursing.
At 6 months old, infants begin to shift from dependence on breast milk or formula as the primary nutrient source to depending on a mixed diet including solid foods. Thus, the consumption of breast milk or formula tends to decrease as the consumption of solid foods increases. It is generally recommended that normal, healthy infants age 7 months and older, who are on solid foods, consume no more than about 32 ounces of infant formula in 24 hours. If older infants still demonstrate signs of hunger after they consume 32 ounces of formula, they may require solid foods fed throughout the day instead of more formula.

Sleepy or Placid Infant

An exception to using the demand feeding approach is for a young infant who is lethargic and sleepy or placid. Some infants may either fall asleep after feeding on a bottle for a short time, may not be easy to wake for feeding every 2 to 3 hours, or do not show signs of hunger normally. To assure that such infants obtain sufficient nourishment, it is advisable for mothers to wait no more than 4 hours (or sooner if the infant's health care provider indicates) between feedings until the infant's first well baby visit (between 2 and 4 weeks old). At that time, the infant's health care provider should be consulted to determine whether to recommend continuation of that practice based on the infant's weight gain. See page 48 for methods to wake a sleepy infant.

It would be appropriate to refer an infant, whose caregiver complains of the infant's sleepiness or lack of hunger signs, to a health care provider for further assessment. Feeding throughout the night is not usually necessary for the older infant with a normal growth rate. See page 105 for information on weaning off bottles.

See figure 9—Guidelines for Feeding Normal Infants, Birth to 1 Year Old, pages 108-109, for approximate ranges of formula intake at different ages.

Bottle Feeding: Tips on Feeding

Caregivers can help their infants to have a positive bottle feeding experience by feeding in a relaxing setting. Encourage caregivers to:

- Find a comfortable place in their home for feeding and to interact with the infant in a calm and relaxed manner;
- Help the infant to be calm in preparation for and during feeding (e.g., by cuddling and talking gently to the infant);
- Take time to communicate with and learn about their infants during feeding; and
- Show their infants lots of love, attention, and cuddling in addition to feeding—reassure them that doing so will decrease fussiness and will not "spoil" the infant.

Guidelines on Feeding a Bottle

To make bottle feeding safe and comfortable for infants, encourage caregivers to:

- Wash their hands with soap and water before feeding;
- Hold the infant in their arms or lap during the feeding (with the infant in a semi-sitting position with the head tilted slightly forward, slightly higher than the rest of the body, and supported by the person feeding the infant, as illustrated below.

The infant should be able to look at the caregiver's face. If an infant's head is tilted back or lying flat down, the liquid could enter the infant's windpipe and cause choking;

- Hold the bottle still and at an angle so that the end of the bottle near the nipple is filled with formula and not air. This reduces the amount of air swallowed by the infant;
- Assure that the formula flows from the bottle properly by checking if the nipple hole is an appropriate size (if the bottle is held upside down, the falling drops should follow each other closely and not make a stream). The nipple ring on the bottle should be adjusted so that air can get into the bottle (otherwise the nipple may collapse); and
- Burp the infant at any natural break in or at the end of a feeding to eliminate swallowed air from the stomach. However, stopping to burp an infant after every couple of ounces can be disruptive to the feeding. An infant can be burped by gently patting or rubbing the infant's back while he or she is held against the front of the caregiver's shoulder and chest or held and supported in a sitting position in the caregiver's lap. Burping at natural breaks during feeding helps to slow the feeding, thereby lessening the amount of air swallowed, and may help to reduce gastroesophageal reflux (see page 122) and colic in some infants. The breaks in feeding are also good times for the caregiver to socialize (e.g., talk gently and smile at) with her infant.

Throughout infancy, it is especially important that bottle-fed infants be fed in a position that both minimizes their chances of choking and allows them physical and eye contact with their caregivers. When an infant is held closely and can establish eye contact with the caregiver, bonding between the two is enhanced. Older infants may prefer to hold the bottle themselves while in the caregiver's arms or lap or while sitting in a high chair or similar chair.

Propping A Bottle Not Recommended

It is never appropriate to prop a bottle to feed an infant (this practice involves laying the infant down and placing a bottle, supported by a pillow or something similar, in the infant's mouth).

Propping a bottle is dangerous because:

- Liquid in the bottle can accidently flow into the lungs and cause choking;
- Infants tend to contract ear infections because fluid enters the middle ear and cannot drain properly; and
- Infants do not receive human contact which is important to make them feel secure and loved.

Similarly, it is not advisable to give infants a bottle (whether propped or not) while:

- Laying down to rest, sleep, or nap;
- Lying in an infant seat; or
- Sitting in an infant swing or walker.

In addition to possibly causing choking and ear infections, these practices can lead to dental problems if there is anything but water in the bottle (see page 114 regarding nursing bottle caries).

See page 105 regarding weaning from the bottle.

Selection, Preparation, and Storage of Infant Formula

To assure that infant formula is safe for consumption, the formula must be properly selected, prepared, and stored and bottles must be properly sanitized.

Selecting Cans of Infant Formula

Encourage caregivers to take these steps when selecting and using cans of infant formula:

- Check the formula's expiration date on the label or the lid. If the expiration date has passed, then the formula has expired and should not be selected.
- Do not select cans of infant formula that have dents, leaks, bulges, puffed ends, pinched tops or bottoms, or rust spots. These characteristics indicate that the product quality may be diminished and the product unsafe.
- Store cans of infant formula in a cool indoor place—not in vehicles, garages, or outdoors.
- Before opening a can of infant formula, wash the can lid with soap and water to remove bacteria, dust, insect parts, and other substances that could contaminate the formula when opened. Rinse soap off thoroughly with water so that soap does not get into the formula.

Sanitizing Bottles and Preparing Infant Formula

It is important that caregivers know how to sanitize bottles and that those using concentrated and powdered infant formulas understand how to dilute and prepare the formula correctly. Improperly sanitized bottles may contain harmful micro-organisms which could cause illness in infants. Infants consuming incorrectly diluted formula may develop serious health problems. Underdiluted formula (containing too little water) puts an excessive burden on an infant's kidneys and digestive system and may lead to dehydration. This problem becomes even worse if the infant has an increased water need due to fever or infection. Overdiluted formula (containing too much water) may contribute to growth problems, nutrient deficiencies, and could lead to water intoxication (see pages 18-19 for more information).

There are two methods to prepare formula in a sanitary manner: the aseptic and *terminal methods. Figures 7a, b, and c, on pages 80-82, include instructions on the preparation of standard milk- and soy-based concentrated, powdered, and ready-to-feed infant formulas using the aseptic method. This method involves boiling the bottles and their parts in water first, and then filling them with properly diluted formula.

Although infant formula cans include written instructions for formula preparation, caregivers may not be able to read or understand those instructions. If they are unable to read English but can read another language, printed instructions can be provided in their own language. Formula preparation instructions designed in picture format can be used for those who cannot read.

** The terminal method involves filling clean bottles with properly diluted formula first and then boiling all the formula-containing bottles in water. This method is not recommended because commercial infant formula has already been sterilized and because boiling destroys certain nutrients (e.g., folate) in the formula.*

Sterilizing Water and Bottles

Infants under age 3 months are more likely to contract illnesses from micro-organisms in bottles and nipples which are improperly cleaned, cleaned in contaminated water, or filled with contaminated water. Therefore, for infants less than 3 months old, glass or hard plastic bottles and bottle parts (nipples, caps, rings) should first be thoroughly cleaned using soap, hot water, and bottle and nipple brushes, and then either be sterilized in boiling water for 5 minutes, as indicated in figures 7a, 7b, and 7c, pages 80-82, or washed in a properly functioning dishwasher machine. If disposable plastic bottle liners are used, the bags should be discarded after one use and the nipples, rings, and caps still sterilized in boiling water or washed in a dishwasher until the infant is at least 3 months old. After 3 months, unless otherwise indicated by a health care provider, bottles should be thoroughly washed using soap and hot water and bottle and nipple brushes or cleaned in a dishwasher.

As a precaution, it is generally recommended to preboil the water used for formula preparation during the first 3 months of life. Caregivers should consult with their health care providers regarding whether the water used for preparing infant formula or for feeding should be boiled for the infant older than 3 months. If a caregiver is in doubt about the safety of the water supply or if there are reports in the community about the water supply being contaminated, it would be wise to boil the water before use as described below or find an alternative source of clean water (see pages 21-22).

Caregivers can preboil water by bringing the water to a rolling boil, boiling it for 5 minutes, and then letting it cool. See pages 20-22 regarding the use of different types of water, including well water, and the importance of avoiding prolonged boiling to reduce potential lead and nitrate concentration.

Storing Infant Formula

Prepared infant formula is a highly perishable food which must be stored properly in order to be safe for consumption. *The following guidelines are recommended to prevent spoilage of infant formula:*

- Store bottles of formula in a properly functioning refrigerator until ready to use. Bacterial growth is slowed when the formula is kept in a refrigerator, at temperatures at or below 40° F. (Use a special thermometer to test if the refrigerator is 40°F or below.) Use refrigerated bottles of formula within 48 hours of the time they were prepared. Opened cans of formula should be covered, refrigerated, and used within 48 hours. Freezing of infant formula is not recommended.
- When preparing formula to be stored, pour the formula into bottles in single feeding portions (e.g., pour 26 ounces of properly diluted formula into five bottles each containing 4 to 6 ounces).
- Discard formula remaining in a bottle after a feeding. The mixture of formula with saliva provides an ideal breeding ground for disease-causing micro-organisms.
- Do not feed an infant a bottle left out of the refrigerator for more than 2 hours.
- Before reusing any bottles or their parts, they should be cleaned and sanitized as described above under "Sterilizing Water and Bottles."

Traveling with Infant Formula

When traveling, caregivers can take along a can of powdered infant formula and separate water in clean bottles (or sterilized bottles for infants under 3 months old). Then, the formula can be mixed up to make single bottles when needed. Alternately, nursettes or single cans of ready-to-feed formula can be used. It is not recommended to travel with unrefrigerated bottles of prepared formula held at room temperature for an extended time.

Warming Infant Formula

The following guidelines are recommended to warm refrigerated infant formula:

- For infants who prefer a warmed bottle, warm the bottle immediately before serving.
- A safe method of warming a bottle is to hold it under running warm tap water. Shake the bottle before testing the temperature.

Always test the temperature before feeding to make sure that it is not too hot or cold (test by squirting a couple of drops onto the back of your hand).

- Warm only as much infant formula as you think will be needed for a feeding.
- **Never use a microwave oven to warm infant formula because this practice is dangerous.** Liquid in a bottle may become very hot when heated in a microwave oven and remain hot afterwards even though the bottle feels cool. Infants have been seriously burned while being fed liquids warmed in microwave ovens. Covered bottles, especially vacuum-sealed and metal-capped bottles of ready-to-feed formula, can explode when heated in a microwave oven.

Guidelines for Infant Formula Use When There is Limited Access to Common Kitchen Appliances

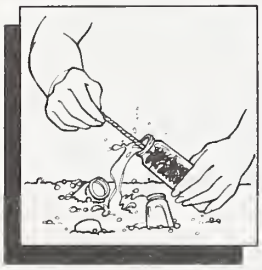
The following guidelines regarding use of standard milk- and soy-based infant formulas are recommended for caregivers with limited access to a refrigerator or stove (or when their own appliances are not functioning properly; e.g. a caregiver's refrigerator is not working and keeping foods at or below 40° F):

- *If there is no access to a refrigerator:*
  - Use powdered infant formula instead of 32-ounce ready-to-feed cans or 13-ounce concentrated cans. The latter two are designed for the preparation of multiple bottles of formula at one time and require use of a refrigerator for storage. Alternately, ready-to-feed infant formula in 8-ounce cans or in nursette bottles (individual serving bottles in 4- or 8-ounce sizes) can be used. Follow instructions for properly sanitizing bottles and water (see pages 77, 78, 80-82).
  - If powdered formula is used, prepare one bottle at a time; fill it with the approximate amount of formula that the infant can consume at one feeding. Make sure to scoop the powder out of the can using a clean, dry scoop when preparing formula. Make sure no liquid enters the formula can because it will facilitate the growth of bacteria and spoilage of the formula. See figure 7b, page 81, for more detailed instructions.
  - Use formula immediately after it is prepared, or after a ready-to-feed can or nursette is opened.
  - Discard any formula leftover after a feeding or formula that has been sitting at room temperature for more than 2 hours.
- *If there is no access to a stove:*
  - Nursette bottles are the ideal form of formula to use for infants less than 3 months old when a stove and a pot (for sterilizing bottles and their parts and boiling the water) are not available.

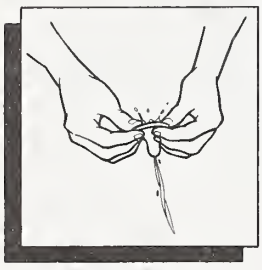
Figure 7a

Preparation Checklist for Standard Milk- and Soy-based Concentrated Infant Formula (Aseptic Method) (using glass or hard plastic bottles)

Wash your hands with soap and hot water. *Rinse thoroughly.*

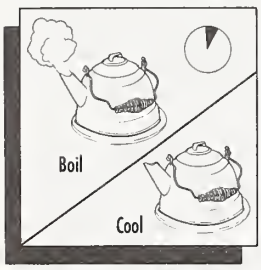


Wash bottles and nipples, using bottle and nipple brushes, and caps, rings, and preparation utensils in hot soapy water before using. *Rinse thoroughly.*



Squeeze clean water through nipple holes to be sure they are open.

*Put the bottles, nipples, caps, and rings in a pot and cover with water. Put the pot over heat, bring to a boil, and boil for 5 minutes.



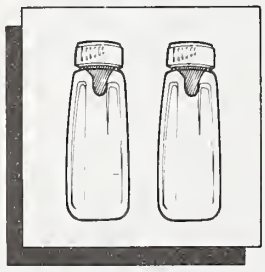
**For formula, boil more water for 5 minutes and let it cool. Use this water to mix the formula.

Wash the top of the can with soap and water and rinse well. Wash the can opener.

SHAKE CAN WELL and then open the can.

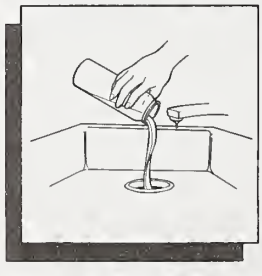
Pour needed amount of formula into a clean bottle using ounce markings to measure formula and add an equal amount of cooled boiled water. Thus, if 4 oz. of formula is poured into the bottle, 4 ounces of water should also be added.

Attach nipple and ring to the bottle and *SHAKE WELL. Feed prepared formula immediately.*



If more than one bottle is prepared, put a clean nipple upside down on each bottle and cover it with a cap and screw-on ring.

Do not leave formula at room temperature for more than 2 hours. Refrigerate bottled formula until needed. *Use within 48 hours.* If formula is left in the can, cover and refrigerate open can until needed. *Use within 48 hours.*



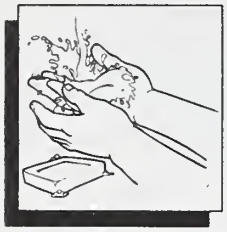
Discard unused formula left in bottle after feeding.

*This step is for infants less than 3 months old, unless a health care provider indicates otherwise. A properly functioning dishwasher machine can be used to clean bottles and bottle parts instead of boiling them in a pot.

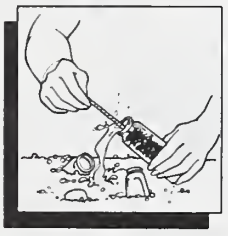
**See page 78 of text for further information.

Figure 7b

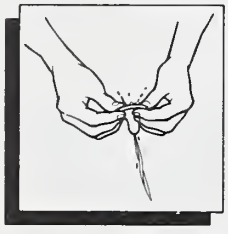
Preparation Checklist for Standard Milk- and Soy-based Powdered Infant Formula (Aseptic Method) (using glass or hard plastic bottles)



Wash your hands with soap and hot water.
Rinse thoroughly.

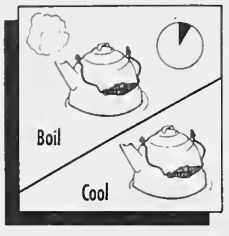


Wash bottles and nipples, using bottle and nipple brushes, and caps, rings, and preparation utensils in hot soapy water before using. *Rinse thoroughly.*

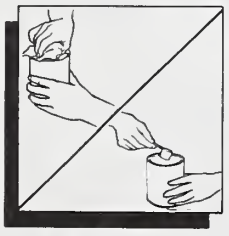


Squeeze clean water through nipple holes to be sure they are open.

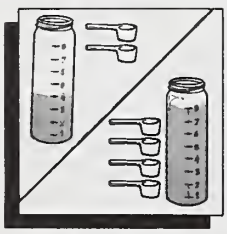
*Put the bottles, nipples, caps, and rings in a pot and cover with water. Put the pot over heat, bring to a boil, and boil for 5 minutes.



** For formula, boil more water for 5 minutes and cool.

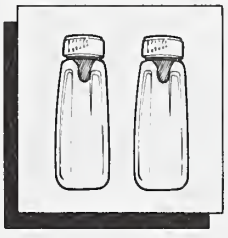


Remove plastic lid. Wash the top of the can with soap and water, rinse well, and dry. Wash the can opener. Open the can and remove scoop. Make sure that the scoop is totally dry before scooping out powdered formula. Only use the scoop that comes with the formula can.

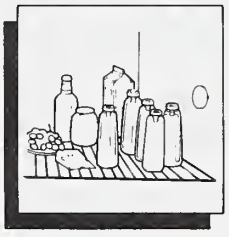


For each 2 ounces of cooled boiled water added to a clean bottle, carefully add 1 level scoop of powdered formula. Thus, if 8 ounces of water is poured into the bottle, 4 scoops of formula should be added.

Attach nipple and cap and SHAKE WELL.
Feed prepared formula immediately.



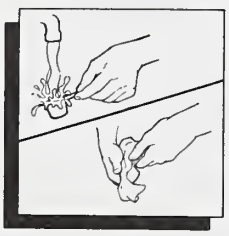
If more than one bottle is prepared, put a clean nipple upside down on each bottle and cover it with a cap and screw-on ring.



Do not leave formula at room temperature for more than 2 hours. Refrigerate bottled formula until needed.
Use within 48 hours.

Discard unused formula left in bottle after feeding.

Make sure that no water or other liquid gets into the can of powder. Cover opened can tightly and store in a cool dry place (not in the refrigerator). Use within 4 weeks after opening to assure freshness.



To be used again, the scoop should be washed with soap and hot water, rinsed thoroughly, and allowed to air dry. When making formula again, the scoop should be totally dry before using it to scoop powder out of the can.

*This step is for infants less than 3 months old, unless a health care provider indicates otherwise. A properly functioning dishwasher machine can be used to clean bottles and bottle parts instead of boiling them in a pot.

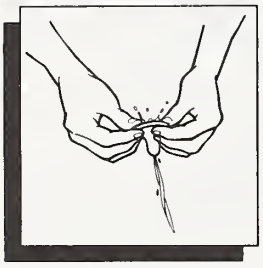
**See page 78 of text for further information.

Figure 7c

Preparation Checklist for Standard Milk- and Soy-based Ready-To-Feed Infant Formula (Aseptic Method) (using glass or hard plastic bottles)

Wash your hands with soap and hot water.
Rinse thoroughly.

Wash bottles and nipples, using bottle and nipple brushes, and caps, rings, and preparation utensils in hot soapy water before using.
Rinse thoroughly.



Squeeze clean water through nipple holes to be sure they are open.

*Put the bottles, nipples, caps, and rings in a pot and cover with water. Put the pot over heat, bring to a boil, and boil for 5 minutes.

Wash the top of the can with soap and water and rinse well. Wash the can opener.

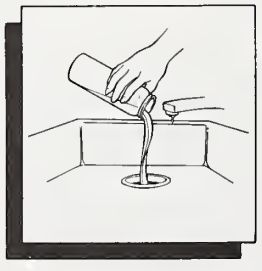
SHAKE CAN WELL and then open the can.

Pour the amount of ready-to-feed formula for one feeding into a clean bottle. *Do not add water or any other liquid.*

Attach nipple and cap and *SHAKE WELL. Feed prepared formula immediately.*

If more than one bottle is prepared, put a clean nipple upside down on each bottle and cover it with a cap and screw-on ring.

Do not leave formula at room temperature. Refrigerate bottled formula until needed. *Use within 48 hours.* If formula is left in the can, cover and refrigerate open can until needed. *Use within 48 hours.*



Discard unused formula left in bottle after feeding.

*This step is for infants less than 3 months old, unless a health care provider indicates otherwise. A properly functioning dishwasher machine can be used to clean bottles and bottle parts instead of boiling them in a pot.

References

Barton, J.C., Conrad, M.E., and Parmley, R.T. Calcium inhibition of inorganic iron absorption in rats. **Gastroenterology** 84: 90-101, 1983.

CON (Committee on Nutrition), American Academy of Pediatrics. Soy-protein formulas: recommendations for use in infant feeding. **Pediatrics** 73: 359-363, 1983.

_____. **Pediatric Nutrition Handbook.** 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1985.

_____. Prudent life-style for children: dietary fat and cholesterol. **Pediatrics** 78: 521-525, 1986.

_____. Iron-fortified infant formulas. **Pediatrics** 84: 1114-1115, 1989.

_____. The use of whole cow's milk in infancy. **Pediatrics** 89: 1105-1109, 1992a.

_____. Statement on cholesterol. **Pediatrics** 90: 469-473, 1992b.

_____. **Pediatric Nutrition Handbook.** 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1993.

Dobbing, J. **Brain, Behavior and Iron in the Infant Diet.** New York, NY: Springer-Verlag, 1990.

Fomon, S.J. Reflections on infant feeding in the 1970's and 1980's. **Am. J. Clin. Nutr.** 46: 171-182, 1987.

Fomon, S.J., Filer, L.J., Jr., Ziegler, E.E., Bergman, K.E., and Bergman, R.L. Skim milk in infant feeding. **Acta Paediatr. Scand.** 66: 17-30, 1977.

Fomon, S.J., Filer, L.J., Jr., Anderson, T.A., and Ziegler, E.E. Recommendations for feeding normal infants. **Pediatrics** 63: 52-59, 1979.

Fomon, S.J., Ziegler, E.E., Nelson, S.E., and Edwards, B.B. Cow milk feeding in infancy: gastrointestinal blood loss and iron nutritional status. **J. Pediatr.** 98: 540-545, 1981.

Fomon, S.J., Sanders, K.D., and Ziegler, E.E. Formulas for older infants. **J. Pediatr.** 116:690-696, 1990.

Goldman, A.R., Garza, C., Nichols, B.L., Goldblum, R.M. Immunologic factors in human milk during the first year of lactation. **J. Pediatr.** 100: 563-567, 1982.

Harrison, H.L., et al. Goat milk acidosis. **J. Pediatr.** 94: 927, 1979.

Howard, R.B. and Winter, H.S. **Nutrition and Feeding of Infants and Toddlers.** Boston, MA: Little, Brown and Company, 1984.

Lozoff, B., Brittenham, G.M., Wolf, A.W., et al. Iron deficiency anemia and iron therapy effects on infant development test performance. **Pediatrics** 79: 981-985, 1987.

Martinez, G.A., Ryan, A.S., and Malec, D.J. Nutrient intakes of American infants and children fed cow's milk or infant formula. **AJDC** 139: 1010-1018, 1985.

Miller, V., Swaney, S., and Deinard, A.S. Impact of the WIC Program on the iron status of infants. **Pediatrics** 75: 100-105, 1985.

Montalto, M.B. and Benson, J.D. Nutrient intakes of older infants: effect of different milk feedings. **J Am Coll Nutr.** 5: 331-341, 1986.

Montalto, M.B., Benson, J.D., and Martinez, G.A. Nutrient intakes of formula-fed infants and infants fed cow's milk. **Pediatrics** 75: 343-351, 1985.

Nelson, S.E., Ziegler, E.E., Copeland, A.M., et al. Lack of adverse reactions to iron-fortified formula. **Pediatrics** 81: 360-364, 1988.

Oski, F.A. Iron-fortified formulas and gastrointestinal symptoms in infants: a controlled study. **Pediatrics** 66: 168-170, 1980.

Pollitt, E., Hathirat, P., Kotchabhakdi, N. et al. Iron deficiency and educational achievement in Thai children, abstracted. **FASEB** 2: A11196, 1988.

Ryan, A.S., Martinez, G.A., and Krieger, F.W. Feeding low-fat milk during infancy. **Am J. Phys. Anthropol.** 73: 539-548, 1987.

Shank, J.S., Dorsey, J.L., Cooper, W.T., and Acosta, P.B. The vitamin E status of infants receiving cow's milk or milk-based formula, abstracted. **Fed Proc.** 46: 1194, 1987.

Vazquez-Seoane, P., Windom, R., and Pearson, H.A. Disappearance of iron deficiency anemia in a high risk infant population given supplemental iron. **N Engl J Med** 313: 1239-1240, 1985.

Walter, R., DeAndraca, I., Chadud, P., et al. Adverse effect of iron deficiency anemia on infant psychomotor development. **Pediatr. Res.** 23: 650, 1988.

Wilson, J.F. Whole cow's milk, age and gastrointestinal bleeding, Letter to the Editor. **Pediatrics** 73: 879-880, 1984.

Winick, M. **Nutrition, Pregnancy, and Early Infancy.** Baltimore, MD: Williams and Wilkins, 1989.

Woodruff, C. Breastfeeding or infant formula should be continued for 12 months, Letter to the Editor. **Pediatrics** 71: 984-985, 1983.

Yip, R., Kinkin, N.J., Fleshood, L., and Trowbridge, F.L. Declining prevalence of anemia among low-income children in the United States. **JAMA** 258: 1619-1623, 1987a.

Yip, R., Walsh, K.M., Goldfarb, M.G., and Blinkin, N.J. Declining prevalence of anemia in childhood in a middle class setting: a pediatric success story? **Pediatrics** 80: 330-334, 1987b.

Ziegler, E.E. Milk and formulas for older infants. **J. Pediatr.** 117: 576-579, 1990.

Ziegler, E.E., Fomon, S.J., Nelson, S.E., Rebouche, C.J., Edwards, B.B., Rogers, R.R., and Lehman, L.J. Cow's milk feeding in infancy: further observations on blood loss from the gastrointestinal tract. **J. Pediatr.** 116: 11-18, 1990.

Infant Foods

By age 4 to 6 months, most infants reach a point in their development in which they can benefit from having foods other than breast milk or infant formula added to their diets. This chapter reviews current knowledge regarding the introduction of foods, the appropriate types of solid foods to feed an infant, home preparation of baby food, using commercial baby food, how to prevent choking, and other practical aspects of feeding solid foods and beverages. Counseling points which relate to the information presented in this chapter are found in chapter 7, pages 136-145.

Recommendations on the introduction of solid foods provided to caregivers of infants should take into account the infant's developmental stage and nutritional status; coexisting medical conditions; social factors; cultural, ethnic, and religious food preferences of the family; financial considerations and other pertinent factors discovered through the nutrition assessment process. See the Selected Bibliography, pages 172-173, for references on cultural, ethnic, and religious preferences.

Guidelines on Introducing New Foods

Pediatric nutrition authorities agree that solid foods should not be introduced to infants before they are developmentally ready for them. Solid foods, introduced too early, are of little benefit to the infant and may even be harmful. Solid foods, started too late, may cause an infant to develop nutritional deficiencies, miss the period of developmental readiness, and have problems learning to eat foods later. When the right foods are introduced appropriate to the developmental stage of the infant, nutritional requirements can be met and eating and self-feeding skills can develop properly.

Developmental Readiness for Solid Foods

Full-term healthy infants generally reach developmental readiness for solid foods between 4 and 6 months old. From birth through 4 to 6 months, only breast milk or iron-fortified infant formula are required to meet an infant's nutritional needs. By 4 to 6 months, infants begin to show their desire for food by opening their mouths and leaning forward, and they show lack of interest or fullness by leaning back, turning away, pushing the spoon or food away, or closing their mouths (Fomon et al., 1979).

From 4 to 6 months, the following developmental changes occur which allow the infant to tolerate solid foods (CON, 1980):

- The infant's intestinal tract is developing immunologically with defense mechanisms to protect the infant from foreign proteins (thus, the risk of hypersensitivity (allergic) reactions to the proteins in solid foods is reduced);
- The infant's ability to digest and absorb proteins, fats, and carbohydrates, other than those in breast milk and formula, increases rapidly;
- The infant's kidneys are developing the ability to adequately excrete the waste products resulting from foods with a high renal solute load, such as meat; and
- The infant develops the neuromuscular mechanisms needed for recognizing and accepting a spoon, masticating, swallowing nonliquid foods, and appreciating variation in the taste and color of foods.

As an infant's oral skills develop, the thickness and lumpiness of foods can gradually be increased. The texture of foods can progress from pureed to ground to fork mashed and eventually to diced. Commercial baby foods that progress in texture can also be purchased. Infants should only be given foods that are appropriate for their developmental age.

There are relatively simple milestones that infants reach when they are ready to start on solid foods, such as being able to:

- Hold their heads steady and sit with support;
- Draw in their lower lips as a spoon is removed from their mouths; and
- Keep food in their mouths and swallow it rather than pushing it back out on their chins. By 4 to 6 months old, the tongue thrust reflex, which causes the tongue to push most solid objects out of the mouth, usually disappears.

These are signals that an infant is mature enough to begin learning to eat from a spoon. An infant's weight or age alone does not determine his or her readiness for semisolid foods. Each infant develops at his or her own rate.

See figure 1—Sequence of Infant Development and Feeding Skills in Normal, Healthy Full-Term Infants, page 31, and figure 8—How the Recommended Sequence of Introducing Foods Corresponds with Food Textures and Feeding Styles, page 89.

Developmental Delays Affect an Infant's Feeding Skills

An infant's development does not always match his or her chronological age. Infants may be developmentally delayed in their feeding skills due to:

- Prematurity;
- Multiple hospitalizations;
- Low-birthweight;
- Depression;
- Failure to thrive;
- Neuromuscular delay;
- Being abused;
- Not having eaten orally (i.e., fed instead via a tube in the stomach or intravenously) for extended periods;
- Cleft lip or cleft palate; or
- A medical condition, like Down's Syndrome or cerebral palsy.

Infants with these conditions may not be developmentally ready for solid foods at similar chronological ages as full-term, healthy infants. A caregiver of a developmentally delayed infant should have instructions concerning proper feeding from the infant's health care provider or a trained professional in feeding developmentally disabled children. For more information and resources on feeding infants and children with special health care needs, contact:

- A local pediatrician;
- A dietitian or nutritionist specializing in this area (e.g., may be found in the State Health Department, State WIC Program, or in local hospitals);
- A State maternal and child health agency; or
- A dietitian or nutritionist at a University-Affiliated Program for Developmental Disabilities (contact your local or State health department for information on the nearest program).

See the Selected Bibliography, on pages 169-170, for references focusing on nutrition for developmentally delayed infants.

Problems With Introducing Solid Foods Early

Some caregivers introduce solid foods at an early age because they feel that their infants are not satisfied with breast milk or formula alone, are feeding too many times a day, or the foods will make their infants sleep through the night. However, infants who are fed solid foods before they are ready for them may:

- Choke on the food;
- Develop food hypersensitivities (allergies) because of an immature digestive tract; and/or
- Consume less than the appropriate amount of breast milk or infant formula.

Contrary to popular belief among mothers, feeding solid foods early will not help infants sleep through the night or eat fewer times in a day. If a caregiver complains that an infant is not satisfied on the amount of nursing or infant formula provided, a nutrition assessment can be performed to ascertain possible problems.

Figure 8

How the Recommended Sequence of Introducing Foods Corresponds with Food Textures and Feeding Styles

Age of Baby by Month	Birth 1 2 3	4 5	6 7	8 9 10 11 12
Age grouping	Birth through 3 months 	4 months through 6 months 	6 months through 8 months 	8 months through 12 months 
Sequence of Introducing Foods	Breast milk or Infant Formula	Cereal (Fruit juice; only if able to drink from a cup with assistance)	Vegetables and Fruits Fruit juice (can try meat if extra iron source is needed)	Meat and Other Protein-rich Foods (e.g. poultry, legumes, cheese) Crackers, Bread, and Other Grain Products
Texture of Solid Food		Strained/Pureed (thin consistency for cereal)	Mashed	Ground/Finely Chopped; Chopped
Feeding Style	Breastfeeding/Bottle feeding	Spoon Feeding; Cup Feeding		Self Feeding/Finger Foods

Problems With Introducing Solid Foods Very Late in Infancy

By 6 months old, normal healthy infants should be starting to consume some appropriate solid foods. By 8 months, they should be developing skills to feed themselves. The jaw and muscle development which occurs when an infant eats solid foods at the appropriate age contributes to later speech development. Infants who are not introduced to solid foods when developmentally ready for them may:

- **Reject foods when they are introduced at a later age.** This may occur because infants become comfortable with the easier feeding style necessary to suck from the breast or a bottle. The infant may then have difficulty developing skills to eat independently; and
- **Not consume an adequate variety and amount of food to meet their nutritional needs.** Breast milk or infant formula alone do not provide an adequate concentration or balance of nutrients for the older infant.

Therefore, solid foods serve an important purpose in the daily diet of infants who are developmentally ready for them.

Importance of Slowly and Gradually Introducing Each New Food

When starting infants on solid foods, it is recommended that caregivers:

- Introduce new foods one at a time;
- Introduce new foods gradually, i.e., at intervals of no less than about 1 week between each new food;
- Introduce a small amount (e.g., about 1 to 2 teaspoons) of a new food at first (this allows an infant to adapt to a food's flavor and texture);
- Use single-ingredient foods at first to determine each food's acceptance (e.g., try plain rice cereal before rice cereal mixed with fruit); and
- Observe the infant closely for reactions after feeding a new food.

By following these guidelines, an infant will have time to become acquainted with each new food and the caregiver will more easily be able to identify any adverse reactions or difficulties digesting new foods, or foods which are refused.

Major types of adverse reactions to food include:

- **Food hypersensitivities (allergies), which:**
  - Involve a reaction of the immune system to a food; a reaction may occur immediately or hours after eating;
  - May cause any of the following symptoms: diarrhea, vomiting, coughing and wheezing, respiratory symptoms, ear infections, systemic reactions (e.g., anaphylactic shock, failure to thrive), abdominal pain, hives, skin rashes (like eczema), and extreme irritability (CON, 1985); and
  - Are associated most often with consumption of these foods by infants: cow's milk, whole eggs (or egg white), wheat, peanuts or other nuts, finfish (e.g., flounder, trout, cod) and shellfish (e.g., shrimp, crab, lobster, scallop, oyster, clam) (CON, 1985).
- **Food intolerances, which:**
  - Involve reactions stemming from an enzyme deficiency, a toxin, or a disease (the immune system is not affected); and
  - May cause some of the similar symptoms as food hypersensitivities.

  Examples of food intolerances are lactose intolerance (caused by a lack of lactase, the intestinal enzyme that digests the sugar lactose) and gluten intolerance (in which gluten, a combination of proteins found in wheat, rye, oats, barley, and buckwheat, irritates the lining of the small intestine).
- **Other adverse reactions to food**, which do not involve the immune system, include reactions to: food additives (e.g., artificial food colorings), MSG (monosodium glutamate), natural substances in food such as caffeine, or substances or micro-organisms which cause food poisoning. Some infants may develop excessive intestinal gas to certain foods (e.g., certain vegetables, legumes). Anderson and Sogn (1984) provide information on adverse reactions to foods in infants and children.

Caregivers should stop feeding foods that their infants react to and consult with a health care provider about any reactions. If an infant appears to be having a severe reaction to food (e.g., difficulty breathing, shock), a health care provider and/or the rescue squad should be contacted immediately.

Note that some exclusively breastfed infants have been reported to have reactions to foods in their mothers' diets (Lawrence, 1989; Riordan and Auerbach, 1993). If an exclusively breastfed infant has symptoms similar to those described above for food hypersensitivities, referral to a qualified health care provider is appropriate.

Caregivers can encourage acceptance of new foods by showing a positive attitude towards them. New foods that are rejected should not be forced on an infant, but can be offered again in a few weeks or a month. Infants and children will generally accept foods once rejected if time has elapsed since the rejection and if the food is offered "neutrally." It may take time for them to adapt to the flavor and texture of new foods.

Types of Foods to Introduce

Infants can be fed either home- or commercially prepared baby foods. This section reviews the different types of food which are commonly fed to infants. See figure 9, pages 108-109, for guidelines for normal infants on when to introduce foods and approximate quantities to feed.

Iron-Fortified Infant Cereal

Iron-fortified infant cereal is an appropriate first solid food for infants because it is easy to digest and contributes iron to the diet. It is recommended that iron-fortified infant cereal be introduced between ages 4 and 6 months.

Types of Infant Cereal to Feed

A variety of plain iron-fortified infant cereals are available. Iron-fortified infant rice cereal is a good choice as an infant's first solid food because it:

- Is easily digested;
- Is least likely to cause a hypersensitivity (allergic) reaction;
- Contains important nutrients; and
- Can be altered in texture to meet an infant's developmental needs.

After introducing rice cereal, oat and barley infant cereals can be added at 1-week intervals, and wheat cereal can be introduced at age 8 months. Wheat is most likely to cause a hypersensitivity (allergic) reaction in young infants and this risk decreases by around 8 months. Mixed-grain cereals and cereal and fruit combinations may be tried after an infant has been introduced separately to each food in the mixture or combination. Pre-prepared infant cereal in jars contains multiple ingredients, sugar, more kilocalories, and is more expensive, ounce for ounce, than reconstituted dry boxed infant cereals. Infant cereal can be mixed with breast milk, infant formula, fruit juice (after the infant has tried and had no reactions to the juice), or water to prepare it in the appropriate consistency.

Why Adult Cereals Should Be Avoided

Ready-to-eat iron-fortified cereals designed for adults or older children are not recommended for infants because they:

- Often contain mixed grains;
- Tend to contain more sodium and sugar than infant cereals; and
- Contain iron which is not as easily absorbed by the infant compared to the iron in infant cereals.

Infants should not be fed adult cereals with small pieces, such as raisins, dates, or nuts, that are hard to chew and could cause choking.

Fruit Juice

Fruit juice may be introduced to infants when they are able to drink it from a cup with assistance. Although fruit juices contain carbohydrates, may contain vitamin C, and are a source of fluid, they should be fed only in moderation and not in place of breast milk or infant formula.

Guidelines on Introducing Fruit Juice

If fruit juices are introduced, it is generally recommended to:

- Use fruit juice containing or fortified with vitamin C—vitamin C promotes the absorption of iron from other foods;
- Introduce new fruit juices one at a time and not sooner than about 1 week apart, and observe the infant for adverse reactions; and
- Introduce mixed fruit juice only after the infant has tried all the juices in the mixture.

Caregivers should observe their infants after introducing citrus (e.g., orange, tangerine, grapefruit), pineapple, or tomato juices and delay introducing them until the sixth month or older because these juices can cause hypersensitivity (allergic) reactions in some infants (CDA and SSDA, 1992).

Importance of Feeding Juice From A Cup Instead of A Bottle

Whether regular "adult" juices or infant juices are used, infants should be fed juice from a cup. Unfortunately, many commercial infant juices are available in 4- and 8-ounce bottles designed so that a rubber nipple can easily be attached. *Advise caregivers to pour fruit juice into a cup and not feed it from a bottle for these reasons:*

- **To avoid the development of nursing bottle caries** —A bottle of juice is easy for an infant to carry around and drink from frequently. The more frequently juice comes in contact with the teeth, the greater an infant's risk of developing nursing bottle caries (see pages 113-116 for more information); and
- **To avoid excessive consumption of juice**—It is easier to consume excessive amounts of juice when taken from a bottle.

*Infants who drink **large** amounts of juice, from a bottle or cup, may:*

- Consume an inadequate quantity of breast milk, infant formula, or other nutritious foods; or
- In some cases, develop gastrointestinal symptoms, such as diarrhea, abdominal pain, or bloating, from consuming an excessive amount of certain juices (i.e., fruit juices containing a significant amount of sorbitol, a naturally occurring carbohydrate) (CON, 1991). Juices containing sorbitol include prune, pear, cherry, peach, and apple juice (CON, 1991).

Use of Regular Canned Juices

Most canned juices manufactured in the United States are packed in cans coated with a lining designed to reduce the rate at which the can corrodes. Once a can is opened, some corrosion still occurs and may affect the juice's flavor. Thus, it is advisable to store juice from a freshly opened can in a clean glass or plastic container.

Historically, there has been concern about feeding infants canned food or beverages because of the danger of lead from the can seams leaching into the food. However, the seams of cans manufactured in the United States are no longer made using lead solder. It is possible that canned imported juices, found in ethnic, specialty, and regular food stores, may have lead seams. As a precaution, advise caregivers to avoid feeding imported canned juices to their infants. Also, fruit juices should not be stored in lead crystal containers or pottery containers which may leach lead into the juice.

Vegetables and Fruits

Vegetables and fruits are generally introduced between 6 and 8 months. Vegetables and fruits provide infants with carbohydrates, including fiber, vitamins A and C, and minerals.

Introducing Home- and Commercially Prepared Vegetables and Fruits

Home- or commercially prepared vegetables and fruits can be fed to infants. A wide variety of vegetables and fruits can be introduced over time. However, the recommendations to introduce one new food at a time, wait about 1 week between each new food, and watch the infant closely for reactions, still apply.

Guidelines for Home Preparation of Vegetables and Fruits

The texture of soft-cooked vegetables or fruits needs to be appropriately modified for infants.

As an infant's feeding skills progress, the thickness and lumpiness of vegetables and fruits can gradually be increased. Food texture can progress from pureed to ground to fork mashed and eventually to diced.

Recommended guidelines for the preparation of vegetables and fruits include:

- Select high quality fresh vegetables and fruits or plain frozen vegetables and fruits (e.g., without added salt or sauces). Fresh or frozen vegetables or fruits are preferable over canned vegetables or fruits, which may contain added salt or sugar.
- If canned products are used due to their lower cost, those without salt or syrup, or packed in their own juice, are preferable (regular canned products could be rinsed in clean water, but this washes away some nutrients).
- Wash fresh vegetables and fruits with clean water to remove dirt. Remove pits, seeds, and inedible peels and other parts. Edible skins and peels can be removed either before or after cooking.
- When cooking is needed, cook the vegetables or fruit in a covered saucepan on a stove; either boiling with a small amount of water or steaming until just tender enough to be pureed or mashed. A microwave oven can also be used to initially cook these foods. Avoid excessive cooking of vegetables and fruits in order to limit destruction of vitamins. After cooking is finished, the food can be pureed or mashed with liquid until it reaches the desired smoothness. Vegetables puree easier in large quantities in a blender or food processor.
- Examples of vegetables which can be used to make baby foods include: asparagus, broccoli, brussels sprouts, cabbage, carrots, cauliflower, collard greens, green beans, green peas, green peppers, kohlrabi, kale, plantain, potatoes, spinach, summer or winter squash, and sweet potatoes. However, watch the infant for reactions after feeding any of these as new foods. Do not feed home-prepared spinach, beets, turnips, carrots, or collard greens, which are high in nitrates, to infants **under 6 months old**. See below for more information.
- These fresh fruits can be mashed (after peeling) without cooking if ripe and soft: apricots, avocado, bananas, cantaloupe, mango, melon, nectarines, papaya, peaches, pears, and plums. Stewed pitted dried fruits can be pureed or mashed. Apples, pears, and dried fruits usually need to be cooked in order to be pureed or mashed easily. Watch the infant for reactions after feeding any of these fruits as new foods.
- It is not necessary to add salt, sugar, syrups, oil, butter, margarine, lard, or cream to vegetables and fruits prepared for an infant. Honey should never be added to an infant's foods because of the risk of infant botulism (see page 98 for more information).

Use of Commercial Baby Food Vegetables or Fruits

If commercially prepared vegetables or fruits are used, plain varieties are generally preferred instead of fruit desserts or other baby food mixtures with other added ingredients such as sugar, nonfat dry milk, or corn syrup. Plain vegetables and fruits generally offer more nutrient value for the cost of the food compared to fruit desserts and the baby food mixtures.
Commercial baby food fruits and vegetables that progress in texture can be used as the infant's developmental abilities progress. See pages 102-103 on the safe use of commercial baby foods.

Vegetables and Fruits Which May Cause Choking

Due to the risk of choking, it is best to avoid feeding infants these vegetables and fruits:

- Raw vegetables (including green peas, string beans, celery, carrot, etc.);
- Cooked or raw whole corn kernels;
- Hard pieces of raw fruit;
- Whole pieces of canned fruit;
- Whole grapes, berries, or cherries; these fruits should be cut into quarters, with pits removed, before feeding; and
- Uncooked dried fruit (including raisins).

A Caution about Vegetables High in Nitrates or Nitrites

The American Academy of Pediatrics (CON, 1993) indicates that "home-prepared spinach, beets, turnips, carrots, or collard greens are not good choices for feeding during early infancy because they may contain sufficient nitrate to cause methemoglobinemia."

Methemoglobinemia, also termed blue baby syndrome, is characterized by blue skin and difficulty in breathing, and could lead to death. The nitrate in high-nitrate vegetables is converted to nitrite before ingestion or in the infant's stomach. The nitrite binds to iron in the blood and hinders the blood's ability to carry oxygen.

The potential risk of developing methemoglobinemia is only present with home-prepared high-nitrate vegetables; commercially prepared strained and junior spinach, carrots, and beets contain only traces of nitrate (Wilson, 1949; Kamm et al., 1965) and are not considered a risk to the infant (Fomon, 1974; CON, 1970). Thus, advise caregivers not to feed infants less than 6 months old those home-prepared vegetables potentially high in nitrates noted above. See pages 21-22 regarding the risk to infants of consuming water contaminated with nitrate.

Protein-rich foods

Protein-rich foods are generally introduced to infants between 6 and 8 months old. Protein-rich foods include meat, poultry, fish, eggs, cheese, yogurt, and legumes (see pages 6, 118-119 on protein in vegetarian diets). Home- or commercially prepared meats are a good source of iron, in addition to iron-fortified infant cereal, for infants over 6 months old who need extra iron. Introduction of protein-rich foods earlier than 6 months old may cause hypersensitivity (allergic) reactions. For the infant over 6 months, as with all new foods, protein-rich foods should be introduced one at a time, waiting no less than about 1 week between each new food, and the infant watched closely for reactions to the foods.

Types of Protein-rich Foods to Introduce

Home-Prepared Meats, Poultry, and Fish
Infants can be offered well-cooked strained or pureed lean beef, pork, lamb, veal, chicken, turkey, liver, boneless finfish (fish other than shellfish), egg yolk, legumes, tofu, sliced or grated mild cheese, yogurt, or cottage cheese.

Infants should be observed closely if finfish is introduced because these fish can cause hypersensitivity (allergic) reactions in some infants (shellfish is not recommended for infants less than 1 year old). There is also controversy regarding the safety of feeding certain types of fish to infants and young children. Some types of fish may be contaminated with appreciable concentrations of potentially hazardous organic and inorganic chemicals (e.g., polychlorinated biphenyls (PCBs), methylmercury, dioxins, and chlorinated hydrocarbon pesticides) (IOM, 1991b). One study (Consumer Reports, 1992) suggested that high levels of contaminants, which could be detrimental to infant health, may be found in east coast salmon, swordfish, shark, catfish, clams, and lake whitefish. It is advisable for caregivers who consume fresh water sport fish to consult their State department of health or natural resources for information on the safety of these fish before feeding them to their infants.

Recommended guidelines for the preparation, use, and storage of meats, poultry, and fish for baby food include:

Food Storage

- As soon as possible after purchasing meats, poultry, or fish, either store these foods in a refrigerator or cook them. Do not allow these foods to sit out at room temperature. Store these uncooked foods in the coldest part of the refrigerator and prepare them quickly (within 1 day for fish, and 1-2 days for meat and poultry).

Thawing Foods

- If bought frozen, thaw these foods either in a refrigerator or a microwave oven. If

thawed in a microwave oven, cook immediately since parts of the food can become warm when microwaved. Do not thaw these foods on a kitchen counter; bacteria grow rapidly as food thaws at room temperature.

Reduce the Risk of Contamination of Other Foods

- To avoid bacterial contamination of other foods, do not allow raw or partially cooked meat, poultry, fish, or their juices, to come in contact with other foods or the surfaces, serving plates, or utensils used to serve or prepare other foods. For example, do not use a fork to test a piece of meat, poultry, or fish while cooking and then use the fork to mix a cold vegetable dish. Separate cutting boards should be used for animal foods (i.e., meat, poultry, fish) and nonanimal foods (i.e., vegetables, fruits, breads). Regardless of the type of board used, make sure it is thoroughly cleaned with soap and hot water and well rinsed prior to use.

Preparation Before Cooking

- Remove the fat, skin, and bones from meat, poultry, and fish before cooking. Take particular care in removing all the bones, including small ones, from fish. It is more difficult to find all the bones after cooking and bacteria from your hands are destroyed by heat if bones are removed before cooking. After cooking, additional tough inedible parts and visible remaining fat can be removed.

Cooking Guidelines

- Cook meat, poultry, and fish properly and thoroughly to kill any bacteria that might be present in the food and to improve the digestibility of the protein. More specifically:

  - All red meats should be cooked until well done (technically, red meats (including pork) should be cooked to an internal temperature of 160° Fahrenheit). Examples of meats that are undercooked and potentially **unsafe** are: hamburger that is red in the middle, pork that is pink in the middle, and rare and medium-rare steak and roast beef. To check visually, red meat is adequately cooked when it's brown or grey inside.
  - Poultry juices run clear when the meat is done (technically, poultry should be cooked to an internal temperature of 170° Fahrenheit for doneness).
  - Cook fish thoroughly until the flesh is opaque and it flakes easily with a fork (technically, fish should be cooked to an internal temperature of 160° Fahrenheit).

- The best cooking methods include: broiling, baking or roasting, pan broiling, braising, pot roasting, stewing, or poaching (for fish). Oven cooking at temperatures below 325° Fahrenheit is not recommended because temperatures below that level may not heat internal parts of the food sufficiently to kill bacteria.

Never Feed Partially Cooked or Raw Animal Foods

- Never feed infants partially cooked or raw meat, poultry, or fish because these foods may contain harmful micro-organisms that could cause serious food poisoning. Cook pork and lamb until well done to destroy parasites (*Trichinella spiralis* and *Toxoplasmosa gondii*) that may also be present in these meats. Raw fish may harbor parasites and/or high levels of bacteria.

Preparation After Cooking

- After cooking, cut the deboned meat, poultry, or fish into small pieces and puree to the desired consistency. Warm meat is easier to blend than cold meat; chicken, turkey, lamb, and fish are the easiest to puree. Also, meats are easier to puree in a blender or food processor in small quantities. Make sure to clean the blender or food processor thoroughly before using it to make baby food. As an infant's feeding skills mature, meats, poultry, fish, and legumes can be served ground or finely chopped instead of pureed.
- It is not generally recommended to add gravy or sauces to the infant's food.

- Do not masticate (chew) meats before feeding them to the infant (saliva from the caregiver's mouth would contaminate the food with bacteria and dilute its nutrient content).

Meats to Avoid Feeding Infants

- Due to their high salt and/or fat content, hot dogs, sausage, bacon, bologna, salami, luncheon meats, other cured meats, fried animal foods, and the fat and skin trimmed from meats are not generally recommended for infants. Lean meat, poultry, and fish are preferable.

Storage After Cooking

- After cooking, it is very important to either use animal foods immediately or store them in a properly functioning refrigerator (for no longer than 24 hours) or freezer (for no longer than 1 month). Cooked meats held at room temperature provide the perfect medium for bacterial growth. Discard any meat, poultry, or fish which has been left unrefrigerated for more than 2 hours, including serving time.

Tips on the Selection of Commercial Baby Foods Containing Meat Plain commercial baby food meats offer more nutrient value, ounce for ounce, compared to commercial baby food mixed dinners (the mixed dinners do not contain as much protein and iron as the plain meats). Instead of using mixed dinners, the desired amounts of plain meats and plain vegetables could be mixed together. Some infants will accept meat better when it is mixed in this manner. See pages 102-103 on the safe use of commercial baby foods.

Home-Prepared Eggs Egg yolk can be introduced to infants, but egg whites and whole egg (because it has egg white) are not recommended until 1 year old because they contain proteins which may cause hypersensitivity (allergic) reactions in infants. All eggs and egg-rich foods must be carefully handled and properly prepared to reduce the possibility of contamination with *Salmonella enteritidis* and other bacteria. Raw eggs should never be fed to infants (or anyone else) because they may contain bacteria that can cause illness if the egg is eaten uncooked or undercooked.

Recommended guidelines for selection, use for infants, and storage of eggs and egg-rich foods include:

- Buy grade AA or A eggs with clean, uncracked shells. Do not buy unrefrigerated eggs.
- Refrigerate eggs in the original carton, preferably in the main section of the refrigerator which is colder than refrigerator door sections.
- Wash the outside of eggs with clean water before breaking them.
- Cook eggs thoroughly to kill possible bacteria—boil eggs until the yolk is firm and not runny, and then separate the yolk from the white. Only feed infants the yolk part. The hard egg yolk can be mashed with some liquid, like water or infant formula, to the desired consistency.
- Refrigerate eggs or egg-rich foods immediately after cooking or keep them hot. Discard eggs or egg-rich foods if kept out of the refrigerator for more than 2 hours, including serving time.
- Do not feed infants raw or partially cooked eggs or foods that contain them, such as homemade ice cream, mayonnaise, or eggnog. Although most commercial ice cream, mayonnaise, and eggnog are usually made with pasteurized eggs, these products are inappropriate for infants if made with **whole** eggs.

Cheese and Yogurt Cottage cheese, hard cheeses, and yogurt can be gradually introduced as occasional protein foods. Since these foods contain similar proteins as cow's milk, infants should be observed closely for reactions after eating these foods. Cheese can be eaten cooked in foods or in the sliced form. Small slices or strips of cheese are easier and safer to eat than a chunk of cheese which could cause choking.

Legumes (Dry Beans or Peas) and Tofu Cooked legumes (dry beans and peas) or tofu (bean curd made from soybeans) can be introduced into an infant's diet as a protein food. Any cooked dry beans or peas can be used and their consistency modified to be easily eaten by an infant. It is best to introduce small quantities (1 to 2 teaspoons) of mashed or pureed legumes at first (whole beans or peas could cause choking). As with any food, a caregiver should observe to see

if the infant does not like them, has a reaction to the food, or appears to have difficulty digesting them. If so, they can be introduced again at a later date.

Home-prepared dry beans or peas are more economical and lower in sodium than canned beans. However, if canned beans are used, drain the salty water and rinse the beans with clean water before using. Instructions for cooking dry beans and peas can be found on the package label and in many basic cookbooks.

Tofu (bean curd) can also be mashed and fed to infants. Caregivers should select fresh tofu; i.e., tofu prepared daily if made fresh, or water-packed tofu which has not expired. After purchasing, tofu should be:

- Stored immersed in fresh cold clean water; the water should be changed right after purchasing and daily;
- Always stored in a refrigerator; and
- Cooked for a short time (e.g., boil in clean water for about 5 minutes, then allow to cool) before feeding to an infant.

Feeding Water Once Protein-rich Foods are Introduced

Protein-rich foods (e.g., home-prepared meats, commercially prepared plain meats and mixed dinners, egg yolks, cheese) have a higher renal solute load than some other foods. If these foods are fed to an infant, it would be appropriate to feed him or her some water (about 4 to 8 ounces) each day. See page 17 regarding renal solute load.

Grain Products

At about 8 months old, many infants are ready to try crackers, bread, noodles and macaroni, and other grain products. By this stage in their development, infants can practice picking up these foods with their fingers. Grain products provide carbohydrates, thiamin, niacin, riboflavin, iron, and other minerals and, in the case of whole-grain products, fiber to the diet.

Examples of grain products which are appropriate for infants include: plain ground or mashed rice or barley, noodles, plain enriched or whole-grain crackers, preferably low in salt, small pieces of toast or crust of bread, zwieback, teething biscuits, or graham crackers.

Since infants may choke on cooked grain kernels (e.g., cooked rice, wheat berries, barley, or other grain kernels), these foods should be cooked until very soft and then pureed or finely mashed before serving. It is best to mash or finely chop cooked noodles, spaghetti, and macaroni until the infant is 8 to 10 months or older. Older infants can be fed plain crackers, teething biscuits, corn grits, soft tortilla pieces, zwieback, and small pieces of bread as well.

It is advisable for caregivers to avoid feeding their infants these foods which present a choking risk:

- Highly seasoned snack crackers or those with seeds, snack potato or corn chips, pretzels, or cheese twists;
- Breads with nut pieces or whole grain kernels like wheat berries; and
- Whole kernels of cooked rice, barley, wheat, or other grain.

Finger Foods

By the time infants are 8 months old, they can begin to feed themselves with their hands and can try some finger foods. These foods should be:

- Small enough for them to pick up; and
- Soft enough for them to chew on.

Good examples of finger foods include: cooked macaroni or noodles, small pieces of bread, small pieces of soft, ripe peeled fruit or soft cooked vegetables, small slices of mild cheese, crackers, or teething biscuits. To avoid the chances of choking on crumbs, it is best for infants to eat biscuits, small pieces of toast, or crackers only while in an upright position. Peanut butter on crackers is not recommended for infants because the peanut butter can stick to the roof of the mouth and cause choking. See pages 105-106 on choking prevention.

By about 1 year old, most developmentally normal infants are able to almost entirely feed themselves, using their fingers, with chopped foods from the table.

Sweetened Foods and Sweeteners

Sweeteners (e.g., sugar, syrups) eaten alone or added to foods add additional kilocalories to the diet and, as fermentable carbohydrates, promote the development of tooth decay. Sweetened foods may be higher in sugar and fat and lower in key nutrients than other more nutritious foods, such as plain fruit. Plain fruit is a good choice as a dessert for an infant. It is advisable to avoid feeding infants:

- Commercially prepared baby food desserts, or commercial cakes, cookies, candies, and sweet pastries;
- Chocolate—some infants have hypersensitivity (allergic) reactions to this food; and
- Added sugar, glucose, molasses, maple syrup, and corn syrup or other syrups in their food, beverages, or water.

Honey

Honey, including that used in cooking or baking or as found in prepared foods (e.g., yogurt with honey, peanut butter with honey), should **never** be fed to infants. Honey is sometimes contaminated with *Clostridium botulinum* spores. Foods made with honey, which in the preparation process are not heated to a certain temperature, may still contain viable spores. When consumed by an infant, these spores can produce a toxin which may cause infant botulism, a type of serious foodborne illness. The gastrointestinal tract of infants cannot destroy these spores (older children and adults can destroy the small amount of spores in honey). Note that research has shown that corn syrup and other syrups currently on the market are not sources of *Clostridium botulinum* spores, and are not associated with infant botulism (Lilly et al., 1991).

Beverages

Water

Healthy infants fed adequate amounts of breast milk or infant formula in the first 6 months of life generally do not require additional plain water added to their diet. However, infants can be introduced to plain water in small amounts in the first 6 months of life in order to adjust them to its taste. To accommodate the high renal solute load of protein-rich foods, it is advisable for infants consuming those foods to be fed about 4 to 8 ounces of water per day. See pages 17-19 for circumstances, including hot weather and illness, in which infants would require additional fluid and for information on excessive water in the diet and water safety issues.

Caffeine-Containing Beverages

Beverages containing caffeine and theobromine, a caffeine-related substance, are not recommended for infants. Caffeine and theobromine act as stimulant drugs in the body. Coffee, tea, some carbonated beverages such as colas, and hot chocolate contain these substances. In some cultures, infants are commonly fed coffee or tea as a beverage. This practice should be discouraged.

Herbal Teas

Certain herbal teas contain powerful substances similar to drugs and would not be appropriate for infant consumption. See Lawrence (1989) and Siegel (1976) for examples. As a precaution, it would be wise for caregivers to avoid feeding herbal teas to their infants.

Sweetened Beverages

Sodas, fruit drinks, punches, and aides, sweetened gelatin water, sweetened iced tea, and similar drinks are not recommended for infants because of their high sugar content. The sugars in these beverages are fermentable carbohydrates and thus can promote tooth decay (see pages 113-114 for more information). Some caregivers may feed sweetened beverages to their infants when ill. This practice could be dangerous if the infant has symptoms which could lead to dehydration (e.g., diarrhea, vomiting). Caregivers of infants with symptoms such

as diarrhea or vomiting (or signs of dehydration, shown on page 18) should be referred to a health care provider. Appropriate oral rehydration solutions are generally prescribed by health care providers for infants at risk of dehydration.

Artificially Sweetened Low "Calorie" Beverages (or Foods)

Since infants are growing rapidly and require energy for growth, there is no need for low "calorie" beverages in their diets. Further, artificial sweeteners have not been proven safe specifically for consumption by infants. Therefore, beverages such as sodas, iced tea, and fruit punch mixes which contain artificial sweeteners, such as saccharin or aspartame, are not recommended for infants or young children. Similarly, it is also not recommended to feed infants artificially sweetened foods or add artificial sweetener to their foods or beverages.

General Tips on Food Purchasing and Sanitary Food Preparation and Storage

Infants are more susceptible to harmful effects from contaminated food than older children or adults. General cleanliness, proper food selection, and sanitary food preparation and storage are key to preventing food-borne illnesses in infants. The following sections provide general information on cleanliness, equipment to use, and safety and storage of foods.

Foods prepared for an infant at home can be equally nutritious and more economical than commercially prepared baby food. The caregiver using home-prepared baby foods has more control over the variety and texture of food than with commercial baby foods. Care must be taken in preparing an infant's food at home to ensure that the food is:

- Prepared and stored safely;
- Appropriate in texture;
- Cooked using methods which conserve nutrients; and
- Prepared without adding unnecessary ingredients, such as sugar and salt.

Home-Prepared Baby Food

General Guidelines on the Selection, Preparation, and Storage of Home-Prepared Baby Food

Cleanliness Since infants have immature immune systems, they are particularly sensitive to the effects of disease-producing micro-organisms and toxins which may contaminate food. Therefore, it is important to clean anything (hands, surfaces, utensils, equipment) that might come in contact with food before starting preparation.

Key concepts to convey to caregivers on general cleanliness and to reduce contamination of food include:

- Wash hands with soap and hot water and rinse thoroughly:
  - before nursing, bottle feeding, or preparing any food or bottles;
  - **before** handling any food or food utensils and **after** handling raw meat, poultry, or fish;
  - after changing an infant's diaper and clothing; and
  - after using the bathroom.
- Take extra care when handling an infant's food, bottles, and utensils.
- Before preparing food, wash all working surfaces used to prepare food, such as counter

tops or tables, with soap and hot water and then rinse thoroughly with hot water.
- Before preparing food, wash all equipment, such as a blender, food mill, food processor, baby food grinder, utensils, pots, pans, and cutting boards carefully with soap and hot water. Rinse thoroughly with hot water, and allow to air dry. Separate cutting boards should be used for animal foods (i.e., meat, poultry, fish) and nonanimal foods (i.e., vegetables, fruits, breads).

Equipment Common kitchen equipment is all that is necessary to make baby foods at home. A simple metal steamer, available in most supermarkets, can be used to cook fruits and vegetables and will reduce the loss of vitamins in cooking.

These types of equipment can be used to process food into an appropriate texture:

- **Blender or food processor** (purees foods, including meats, vegetables, and fruit, to a very smooth consistency, if desired);
- **Fine mesh strainer** (purees very soft cooked vegetables and ripe or cooked fruits—the food would be pushed through the strainer with the back of a spoon);
- **Baby food grinder or food mill** (purees most foods to a smooth consistency and purees meats to a coarser consistency); or
- **A kitchen fork and/or knife** (for older infants, foods can be mashed with a fork or chopped finely with a knife).

After pureeing food, liquid (cooking liquid, plain water, breast milk, infant formula, or fruit juice) can be added for a thinner consistency. It is generally advisable to avoid adding sugar or salt to an infant's food. When cooking foods for the family, the infant's portion can be separated out before adding those ingredients. Ideally, foods for an infant should be prepared immediately before use and the use of leftover foods avoided. As an infant gets older and progresses in the development of eating skills, the consistency and texture of foods can be altered accordingly.

Strongly discourage caregivers from chewing table foods in their mouths and then feeding the food to their infants. Saliva from the caregiver's mouth would contaminate the food with bacteria and dilute its nutrient content.

See pages 91-97 for detailed information on the preparation of homemade baby foods.

Serving and Storage of Home-Prepared Baby Foods Home-prepared baby foods should either be used immediately, quickly stored in a properly functioning refrigerator, or frozen for longer storage. *Recommended guidelines for serving and storage of home-prepared baby foods after cooking and pureeing include:*

- If planning to use immediately, serve freshly cooked food to an infant shortly after preparation is completed. Allow the food to cool for a short period (10 to 15 minutes) to avoid burning the infant's mouth. Test the temperature of the food before feeding it to the infant.
- Do not allow freshly cooked foods to stand at room temperature or between 40° and 140° Fahrenheit—the temperature zone in which most of the bacteria causing foodborne illnesses thrive. The temperature in a properly functioning refrigerator should be 40° Fahrenheit or below and can be verified with a refrigerator thermometer.
- Refrigerate or freeze home-prepared foods that will not be eaten immediately after cooking and discard the foods if left unrefrigerated for 2 hours, including serving time. Remember the concept "If in doubt, throw it out." That is, if there is any possibility that a perishable food was left unrefrigerated for over 2 hours, discard it. It is not wise to taste the food to see if it is safe because a food can contain disease-producing micro-organisms yet taste normal.
- Use freshly prepared refrigerated food within 48 hours (except meats and egg yolks which should be used within 24 hours).
- Two easy methods of storing baby food (after it has cooled) in serving-size quantities in the freezer include:

  - **Ice cube tray method**—Pour cooked pureed food into sections of a clean ice cube tray; cover with plastic wrap, a lid, or aluminum foil; and place into the freezer. When frozen solid, the cubes can be stored in a freezer container or plastic freezer bags in the freezer.

  - **Cookie sheet method**—Place 1 to 2 tablespoons of cooked pureed food in separate spots on a clean cookie sheet, cover with plastic wrap or aluminum foil, and place into the freezer. When frozen solid, the frozen food pieces can be stored in a freezer container or plastic freezer bags in the freezer.

  Label and date the bags or containers of frozen food and use them within 1 month. When ready to use the frozen baby food, remove the desired number of cubes or pieces and reheat them. The temperature in a properly functioning freezer should be 0° Fahrenheit or below. Since freezers may be opened regularly, the temperature may not always be 0° Fahrenheit. Freezer temperature can be checked with a special thermometer. If frozen foods start melting or getting soft, this is an indication to have the freezer checked.
- Thaw food in refrigerator or under cold running water. Thoroughly reheat refrigerated or frozen home-prepared baby foods before feeding them to an infant. Reheating is important to kill bacteria which can grow slowly while a food is in the refrigerator or during thawing. Test the temperature of the food before feeding it. Discard any uneaten leftover food.
- Do not refreeze baby food. Store thawed food in the refrigerator and use it within 48 hours (24 hours for meats) or discard it.

Caregivers leaving an infant in the care of a babysitter or family member should give explicit instructions for warming, feeding, and handling bottles and food to the temporary caregiver.

Reducing Lead Exposure from Food To reduce an infant's possible exposure to lead from foods, these guidelines are recommended (FDA, 1987):

- Do not feed the infant any canned imported foods or beverages—these cans may have lead seams (lead in seams can enter the food).
- In preparing, cooking, storing, or serving foods for an infant:

  - Avoid using ceramic ware or pottery, especially if imported from another country, for cooking or storing food or beverages.
  - Do not use leaded crystal bowls, pitchers, or other containers to store foods or beverages.

- Never cook or store foods in antique or decorative ceramic or pewter vessels or dishes.
- Do not use antique utensils for preparing or serving foods.
- Store foods or beverages in plastic or regular glass containers.

Commercially Prepared Baby Foods

Commercially prepared baby foods are safe, sanitary, and nutritious alternatives for a caregiver to use when not preparing an infant's foods at home. Baby food is available in jars of varying sizes. If refrigeration is not available to a caregiver, the smallest size baby food jars should be selected and any leftover food discarded.

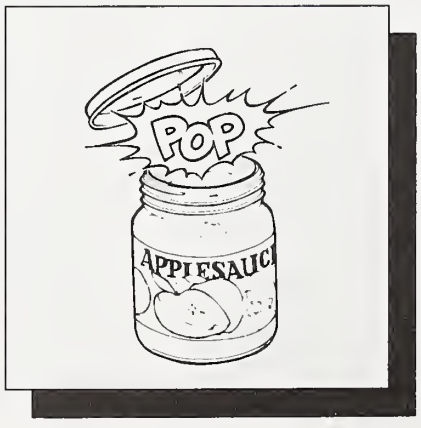
In general, single-ingredient foods are preferred over combination foods or dinners. Combination foods or dinners are more expensive ounce for ounce and usually have less nutritional value by weight than single-ingredient foods. Older infants who are ready for foods with a chunkier texture can be shifted to mashed or finely chopped home-prepared foods instead of baby food combination dinners. It is not necessary to feed infants baby food desserts such as puddings, custards, and cobblers which contain added sugar. Infants can be fed more nutritious and naturally sweet foods such as plain fruit as a dessert.

Encourage caregivers to read the ingredient list on the food label of baby foods. Ingredients are listed on the label in order of those present in the largest amount to the smallest amount. The label can assist the caregiver in determining, for example, which baby foods have more food and less water than others or which contain no added sugar and salt.

Selection, Serving, and Storage of Commercial Baby Foods

It is advisable for caregivers to remember these safety guidelines when selecting and opening baby foods in jars (Consumer Reports, 1986):

- **Avoid sticky or stained jars or those with rusty lids**
  Sticky or stained jars of baby food may be cracked, exposing the food to bacteria, or have glass particles on them from being packed with other cracked jars.
- **Wash the jar of baby food before opening**
- **Check the jar's vacuum seal**
  Baby food jars have a button, or depressed area in the center of the lid, which is an indicator of whether the vacuum seal has been broken. Do not select or use any jar of baby food with the vacuum seal already broken (the button popped out). A popping or "whoosh" noise should be heard when the vacuum seal is broken. To facilitate opening the jar, run it under warm water for a few minutes. Do not tap the jar lid with a utensil or bang it against a hard surface; this could break glass chips into the food. If a grating sound is heard when opening the jar lid, check if there are any glass particles under the lid. Also, always examine the food for any abnormal particles (glass, etc.) when transferring it from the jar to the bowl.



Also, observe "use-by" dates for purchase and pantry storage of unopened baby food jars. If the date has passed, do not use the food.

These safety guidelines are important to remember when serving and storing baby foods:

- **Serve food from a bowl**
  Do not use baby food jars as serving dishes. Infants usually do not finish a jar of baby food at one feeding. If a spoon used for feeding is put back into the jar, the infant's saliva could cause subsequent contamination and spoil the remainder of the food. Thus, remove the desired amount of food from the jar using a clean spoon and put it into a bowl for serving.
- **Discard leftover food**
  Always discard any leftover food in a bowl and do not put it back into the jar.
- **Immediately store an opened jar of unused food and use it quickly**
  After a jar is opened, immediately store it in a refrigerator and use the food within 48 hours, except for baby food meats and egg yolks which should be used within 24 hours. If not used within these time periods, discard the food.
- **Do not microwave jars of baby food**
  Even though the label on some baby food jars indicates that they can be heated in a microwave, this is not recommended because the food may be heated unevenly and some parts of the food may burn the infant's mouth. Instead, remove food from the jar, heat it, stir it, and test its temperature before feeding.

Food Safety Resources

The U.S. Department of Agriculture (USDA) operates a toll-free Meat and Poultry Hotline to address specific food safety concerns. The Hotline is staffed by home economists who can address questions on topics such as proper food handling, how to tell if a particular food is safe to eat, and how to better understand food labels. The nationwide toll-free number is 1-800-535-4555; to talk with a home economist directly, call between 10 a.m. to 4 p.m. eastern time, Monday through Friday. At other times, callers have access to a variety of prerecorded messages on food safety. Callers in the Washington, DC, metropolitan area should call (202) 720-3333. Both phone numbers provide access to a telecommunications device for the deaf. USDA's Food Safety and Inspection Service makes available publications and materials on how to prepare, cook, and store foods safely. Send requests for free copies to: USDA/FSIS/Public Awareness, 14th and Independence Avenue, S.W., Washington, DC 20250. The local Cooperative Extension Service office, listed in the phone book under county government, is also an excellent source of food safety information as are State environmental health agencies or programs.

Practical Aspects of Feeding Solid Foods and Beverages

This section reviews appropriate methods to use in feeding solid foods to an infant, approximate amounts of the different foods to feed, how and when to feed using a cup, appropriate positioning of an infant, equipment to use in feeding solid foods, and information on choking prevention. The information in this section is designed for the developmentally normal infant. Developmentally delayed infants may not be able to eat from the usual utensils, and may require special seating, feeding utensils, bowls, and feeding methods.

Feeding Methods for Solid Foods

Importance of Feeding Foods Using A Spoon

The most appropriate method of feeding pureed or mashed foods to infants is using a spoon. For different reasons, some caregivers add cereal or other foods to the bottle. *However, the practice of feeding solid foods using a bottle is inappropriate for these reasons:*

- **It forces the infant to consume food that may not be needed to meet nutritional requirements.**
- **The infant is taught to eat solid foods incorrectly.** Often the bottle is used to start an infant on solid foods before he or she is developmentally ready to eat those foods from a spoon. Infants benefit developmen-

tally from the experience of eating from a spoon. Different tongue and lip motions are involved in sucking from a nipple than from eating from a spoon.

- **An infant may choke more easily.** Often, when cereal is fed in a bottle, the nipple hole will be cut larger. A wider nipple allows the liquid and cereal or other food to flow through faster which promotes choking.

For similar reasons, "infant feeders" are not recommended for feeding infants. An infant feeder is a hard plastic receptacle with a spout at one end and a plunger at the other end. It allows a caregiver to push a slurry of liquid mixed with food into an infant's mouth.

Note that for infants or children with certain types of medical conditions (such as gastroesophageal reflux), a health care provider may recommend addition of cereal to a bottle. This practice should not be followed unless specifically recommended by the infant's health care provider.

Importance of Sitting Position for Eating

To feed an older infant safely, the infant should be sitting straight up in a comfortable highchair (or similar chair) and secured in the chair. This practice reduces the risk that the infant will choke on the food or fall out of the chair. An infant who is lying down with food or eating while playing, walking, or crawling can easily choke.

Use of Spoon, Bowl, and Fingers for Eating

The process of feeding a young infant is facilitated when a small spoon that easily fits into the mouth is used, and the food is placed in a small plastic unbreakable bowl or dish with edges that are not sharp. Spoons should be made of unbreakable material that will not splinter if an infant bites on it. However, infants should be permitted to "explore" their food with their hands as they get older—by doing so they will have an easier time learning to feed themselves. Thus, although a spoon and bowl may be used for the older infant, it is appropriate to allow these infants to pick up food and eat it with their fingers. Encourage caregivers to be patient and accept that their infants will make a mess when eating; this is a natural part of learning for an infant.

Washing an Infant's Hands Before Eating

It is advisable for caregivers to wash an infant's hands and face frequently and especially before he or she eats. An infant's hands can pick up harmful micro-organisms, lead paint chips, etc. which may be consumed during eating if not washed away.

Recommended Amounts of Solid Foods

When an infant is ready to begin solid foods, the caregiver can start with small servings of 1 to 2 teaspoons of individual foods once a day and gradually increase the serving size to 2 to 4 tablespoons or more of each food per feeding. A 4- to 6-month-old infant may start out with one meal per day including solid foods, then gradually work up to about three meals and two to three snacks per day, at 8 months old.

Since an infant's appetite influences the amount of food eaten on a particular day, there is day-to-day variation in the quantity of food consumed. If fed commercial baby foods, most infants will not be able to finish a whole jar of food in one meal. Thus, for food safety reasons, food should be removed from the jar for feeding. A spoon which has been in an infant's mouth should not go back into the jar. Uneaten portions that have been removed from the jar should not be returned to the jar. It is not appropriate to encourage or force infants to finish what is in their bowl or to eat a whole jar of baby food if they indicate that they are full.

Encourage caregivers to let their infants determine how much they eat. Infants indicate that they are interested in consuming additional solid foods by opening their mouths and leaning forward. *They indicate that they are full and satisfied by:*

- Pulling away from the spoon;
- Turning their heads away;
- Playing with the food;
- Sealing their lips;
- Pushing the food out of their mouths; or
- Throwing the food on the floor.

Infants may want to eat less food when teething or not feeling well and more food on days when they have a very good appetite.

For more information on amounts and types of food to introduce at different ages and sample meals, see figure 9, Guidelines for Feeding Normal Infants, Birth to 1 Year Old, pages 108-109. The ranges in food quantities given in this figure are for general reference; an infant may want to eat slightly less or more than the amounts listed.

Drinking From A Cup

Some infants from 4 to 5 months old may be able to drink or suck small amounts of liquid from a cup when held by another person. At about 6 months, most infants develop the ability to, with assistance, drink from a cup with some liquid escaping from their mouths. After 8 months old, when infants begin to curve their lips around the rim of a cup, they are able to drink from a cup with less spilling. Reassure caregivers that spills and some mess normally occur as an infant learns to use a cup, and that maintaining patience during this time is important. *Caregivers can help their infants learn how to drink from a cup by:*

- Introducing small amounts (1 to 2 ounces) of infant formula, breast milk, fruit juice, or water in a "baby-sized" regular plastic cup;
- Holding the cup for the young infant; and
- Feeding very slowly; i.e., tilting the cup so that a very small amount of liquid (one mouthful) leaves the cup; then, the infant can swallow without hurry.

Weaning From a Bottle

Weaning an infant from a bottle to a cup is a gradual process requiring the infant to learn new skills. Some infants learn to drink from a cup more easily than others. To make weaning easier, a cup can be introduced in place of a bottle at the feeding of least interest or at mealtimes when other family members are drinking from cups. Generally, the infant will not consume the same quantity of fluid from a cup as from a bottle at one sitting. Caregivers should try to totally wean their infants off bottles and onto a cup by about 12 months old. Studies show that children still feeding from a bottle beyond 12 months may be at risk for nursing bottle caries (Fass, 1962; Winter et al., 1971; Walton and Messer, 1981).

Choking Prevention

Choking is a major cause of fatal injury in infants and young children. Normally when eating, the airway to the lungs is blocked off as food passes to the esophagus on its way to the stomach. This prevents food from passing into the airway. However, in infants or young children, choking can occur more easily because the airway is not always blocked off properly when swallowing, allowing food to enter the airway and prevent breathing. Choking may also occur when food is inhaled directly into the airway.

Since choking can occur anywhere and anytime an infant is eating, strongly encourage caregivers to:

- Use correct feeding and food preparation techniques, see pages 100, 103-104;
- Avoid feeding their infants those foods known to be a risk, modify them to make them safer, or substitute foods that may cause choking with a safe alternative food. Examples of modifying and substituting foods include the following:
  - Cut round foods, like cooked carrots, into short strips rather than round pieces. Whole grapes, cherries, or berries should be cut into quarters, with pits removed, before feeding.
  - Substitute meat chopped up or mashed hamburger instead of hot dogs or pieces of tough meat;
- Do not feed whole grain kernels of wheat, barley, rice, etc. to an infant. These grains must be cooked and finely ground or mashed before being fed to an infant;
- Feed small portions and encourage their infants to eat slowly;
- Avoid teething pain medicine before meals;
- Maintain a calm atmosphere during eating time (i.e., avoid too much excitement or disruption during eating); and
- Closely supervise mealtimes.

Certain eating behaviors increase an infant's risk of choking on food and should be avoided. These include:

- Propping a bottle in an infant's mouth;
- Feeding using a bottle with a nipple having too large a hole;
- Feeding solid foods to an infant who is not developmentally ready for them;
- Feeding an infant too quickly;
- Feeding while an infant is lying down, walking, talking, crying, laughing, or playing;
- Feeding difficult-to-chew foods to infants with poor chewing and swallowing abilities;
- Feeding an older infant without close supervision; and
- Feeding foods that may cause choking.

A food's potential to cause choking is usually related to one or more of the following characteristics:

- **Size:** Both small and large pieces of food may cause choking. Small hard pieces of food (such as nuts and seeds, small pieces of raw hard vegetables) may get into the airway if they are swallowed before being chewed properly. Larger pieces may be more difficult to chew and are more likely to completely block the airway if inhaled.
- **Shape:** Food items shaped like a sphere or cylinder may cause choking because they are likely to block the airway more completely than other shapes. Some examples are whole grapes, hot dog-shaped products, and round candies.
- **Consistency:** Foods which are firm, smooth, or slick may slip down the throat. Some examples are whole grapes, nuts, hard candy, hot dog-like products, large pieces of fruit with skin, whole pieces of canned fruit, and raw peas. Dry or hard foods may be difficult to chew and easy to swallow whole. Some examples are popcorn, nuts and seeds, small hard pieces of raw vegetable, cookies, pretzels, and potato chips. Sticky or tough foods (like peanut butter, dried fruit, tough meat, sticky candy) may not break apart easily and may be hard to remove from the airway.

In summary, the following foods are not recommended for infants and young children because they are associated with choking:

- tough meat
- peanuts or other nuts and seeds
- hard candy
- marshmallows
- popcorn
- hot dogs or sausages
- potato/corn chips
- large chunks of cheese
- cooked or raw whole-kernel corn
- plain wheat germ
- fish with bones
- cookies
- whole grapes, berries, or cherries
- uncooked raisins and other dried fruit
- chewing gum
- peanut and other nut/seed butters
- whole beans
- hard pieces of raw fruit
- whole grain kernels
- raw vegetable pieces (e.g., carrots, green peas, string beans, celery, etc.) or hard pieces of partially cooked vegetables
- whole pieces of canned fruit (cut them up instead)
- fruit pieces with pits.

See page 97 for a list of acceptable finger foods.

See appendix D, page 167, for the fact sheet, "What Can You Do When a Child Is Choking?" This fact sheet can be reproduced for your clients. Also, the local chapter of the American Heart Association, American Lung Association, and the American Red Cross can be contacted for pamphlets and posters on choking prevention.

Figure 9: Guidelines for Feeding Normal Infants, Birth to 1 Year Old
(Note: These are general guidelines for the average infant, the number and size of servings may vary with individual infants)

Age	Breast milk or Infant Formula	Groin Products	Juices	Vegetables	Fruits	Protein Food
0-4 MONTHS	**Breast:** Birth to 4 weeks: 8-12+ feedings From 1-4 months: 6-10+ feedings **Formula:** 14-43 ounces	None	None	None	None	None
4-6 MONTHS	**Breast:** 6-8+ feedings **Formula:** 27-49 ounces	Iron-fortified infant cereals 1 to 2 servings per day (total of about 1 to 8 Tbs., after mixing, per day)	Infant or regular 100 percent fruit juice (begin *only* if able to drink from a cup with assistance) Avoid citrus, pineapple, & tomato juices	None	None	None
6-8 MONTHS	**Breast:** 4-6+ feedings **Formula:** 27-32 ounces Can begin to offer some formula in a cup	Iron-fortified infant cereals 2 servings per day (total of about 4 to 8 Tbs., after mixing, per day) Can try crackers, small pieces of toast, zwieback at 8 months	Infant juices or regular 100 percent fruit or vegetable juice 2 to 4 ounces per day, only from a cup	Plain strained or pureed cooked vegetables 1-2 servings per day (total of about 4 to 8+ Tbs. per day)	Plain strained or pureed fresh or cooked fruits 1-2 servings per day (total of about 4 to 8+ Tbs. per day)	Protein foods may be introduced (e.g., plain strained or pureed meats may be introduced if an additional food source of iron is needed)
8-10 MONTHS	**Breast:** 4-6+ feedings **Formula:** 24-32 ounces Can continue to offer formula in a cup	Iron-fortified infant cereals (about 4 to 8+ Tbs., after mixing, per day) Other grain products (2-3 servings per day)	Infant juices or regular 100 percent fruit or vegetable juices 4 oz. per day, only in a cup	Pureed or mashed cooked homemade or junior vegetables 2 servings per day (total of about 4 to 8+ Tbs. per day)	Pureed or mashed fresh or cooked fruits or junior fruits 2 servings per day (total of about 4 to 8+ Tbs. per day)	Pureed, finely chopped, or plain strained lean meat, poultry, or fish, egg yolk, cheese, yogurt, mashed beans or peas (total of about 1 to 6 Tbs. per day)
10-12 MONTHS	**Breast:** 4-6+ feedings **Formula:** 24-32 ounces Can continue to offer formula in a cup	Iron-fortified infant cereals (about 4 to 8+ Tbs., after mixing, per day) Other grain products (2-3 servings per day)	Infant juices or regular 100 percent fruit or vegetable juices 4 oz. per day, only in a cup	Mashed or chopped cooked homemade or junior vegetables 2 servings per day (total of about 6 to 8+ Tbs. per day)	Mashed or chopped fresh or cooked fruits or junior fruits 2 servings per day (total of about 6 to 8+ Tbs. per day)	Pureed or chopped lean meat, poultry, or fish, egg yolk, cheese, yogurt, mashed beans or peas (total of about 2 to 8 Tbs. or 1 to 2 oz. per day)

Continued

Figure 9: Guidelines for Feeding Normal Infants, Birth to 1 Year Old (Note: These are general guidelines for the average infant, the number and size of servings may vary with individual infants)—*Continued*

Age	Breast milk or Infant Formula	Grain Products	Juices	Vegetables	Fruits	Protein Food
COMMENTS	By about 12 months, try to wean entirely off the bottle and onto a cup. Note: Plain water (about 4 to 8 ounces per day) is recommended after a variety of solid foods are introduced and under some special circumstances (see pages 17-18).	Examples of other grain products include crackers, zwieback, bread, noodles, mashed rice, corn grits, soft tortilla pieces. Avoid wheat cereals until 8 months. Do not add sugar or syrups to cereal. Never add honey to cereal or any foods. Avoid foods which may cause choking such as: adult cereals, popcorn, whole grain kernels, plain wheat germ, granola.	Juice should not be fed in a bottle. Avoid feeding soda, fruit punches, aides, and drinks, gelatin water, coffee, or tea. Avoid feeding excessive juice. Watch carefully for reactions to citrus, pineapple, and tomato juices.	It is not necessary to add salt, sugar, oil, butter, other fats, or seasonings. Avoid foods which may cause choking such as: corn, peas, raw vegetable pieces or hard pieces of partially cooked vegetables, potato and corn chips.	Plain fruits are preferable to fruit desserts and mixtures and canned fruit in syrup. Do not add sugar or syrups to fruits. Never add honey to fruit or any foods. Remove seeds and pits from fruit. Avoid foods which may cause choking such as: whole pieces of canned fruit, whole grapes, berries, or cherries, uncooked dried fruit, and hard pieces of fruit or fruit pieces with pits.	Plain meats and plain vegetables are preferable to combination dinners. Avoid fried meats, gravies, sauces, peanut butter, processed meats (hot dogs, luncheon meats, bacon, sausage). Check carefully for bones (especially in fish). Watch carefully for reactions to fish; do not feed any shellfish, whole eggs, or egg whites before 1 year. Avoid foods which may cause choking such as: hot dog-like products, peanuts or other nuts and seeds or their butters, tough meat, whole beans, cheese chunks. Feed about 4 to 8 oz. water each day to the infant on protein foods.

Bibliography:
- Chicago Dietetic Association and the South Suburban Dietetic Association. **The Manual of Clinical Dietetics**. Chicago, IL: The American Dietetic Association, 1992.
- NRC (National Research Council). **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989.
- Owen, A.L. **Feeding Guide: A Nutritional Guide for the Maturing Infant.** Blaamfield: Health Learning Systems Incorporated, 1980.
- Pemberton, et al. **Mayo Clinic Diet Manual: A Handbook of Dietary Practices.** Philadelphia, PA: B.C. Decker Inc., 1988.
- Scipien, G.M., et al. **Comprehensive Pediatric Nursing.** New York: McGraw Hill Book Co., 1979.

References

Anderson, J.A. and Sogn, D.D. (eds). American Academy of Allergy and Immunology Committee on Adverse Reactions to Foods and the National Institute of Allergy and Infectious Diseases. **Adverse Reactions to Foods.** Washington, DC: U.S. Department of Health and Human Services, NIH Pub. No. 84-2442, July 1984.

CDA and SSDA (Chicago Dietetic Association and the South Suburban Dietetic Association). **The Manual of Clinical Dietetics.** Chicago IL: The American Dietetic Association, 1992.

CON (Committee on Nutrition), American Academy of Pediatrics. Infant methemoglobinemia: The role of dietary nitrate. **Pediatrics** 46: 475-477, 1970.

_____. On the feeding of supplemental foods to infants. **Pediatrics** 65:1178-1181, 1980.

_____. **Pediatric Nutrition Handbook**. 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1985.

_____. The use of fruit juice in the diets of young children. **AAP News** 7: 11, 1991.

_____. **Pediatric Nutrition Handbook.** 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1993.

Consumer Reports. Is baby food good enough for baby? **Consumer Reports** September 1986, p. 593-599.

_____. Is our fish fit to eat? **Consumer Reports** February 1992, p. 103-114.

Fass, E.N. Is bottle feeding of milk a factor in dental caries? **J. Dent. Child.** 29: 245-251, 1962.

Fomon, S.J., Filer, L.J., Jr., Anderson, T.A., et al. Recommendations for feeding normal infants. **Pediatrics** 63:52, 1979.

IOM (Institute of Medicine). **Seafood Safety. Report of the Committee on Evaluation of the Safety of Fishery Products, Food and Nutrition Board, Institute of Medicine.** Washington, DC: National Academy Press, 1991.

Kamm, L., McKeown, G.G., and Smith, D.M. Food additives: new colorimetric method for the determination of the nitrate and nitrite content of baby foods. **J. Assoc. Official Agr. Chem.** 48:892, 1965.

Lecos, C.W. Pretty poison: lead and ceramic ware. **FDA Consumer** July/August 1987.

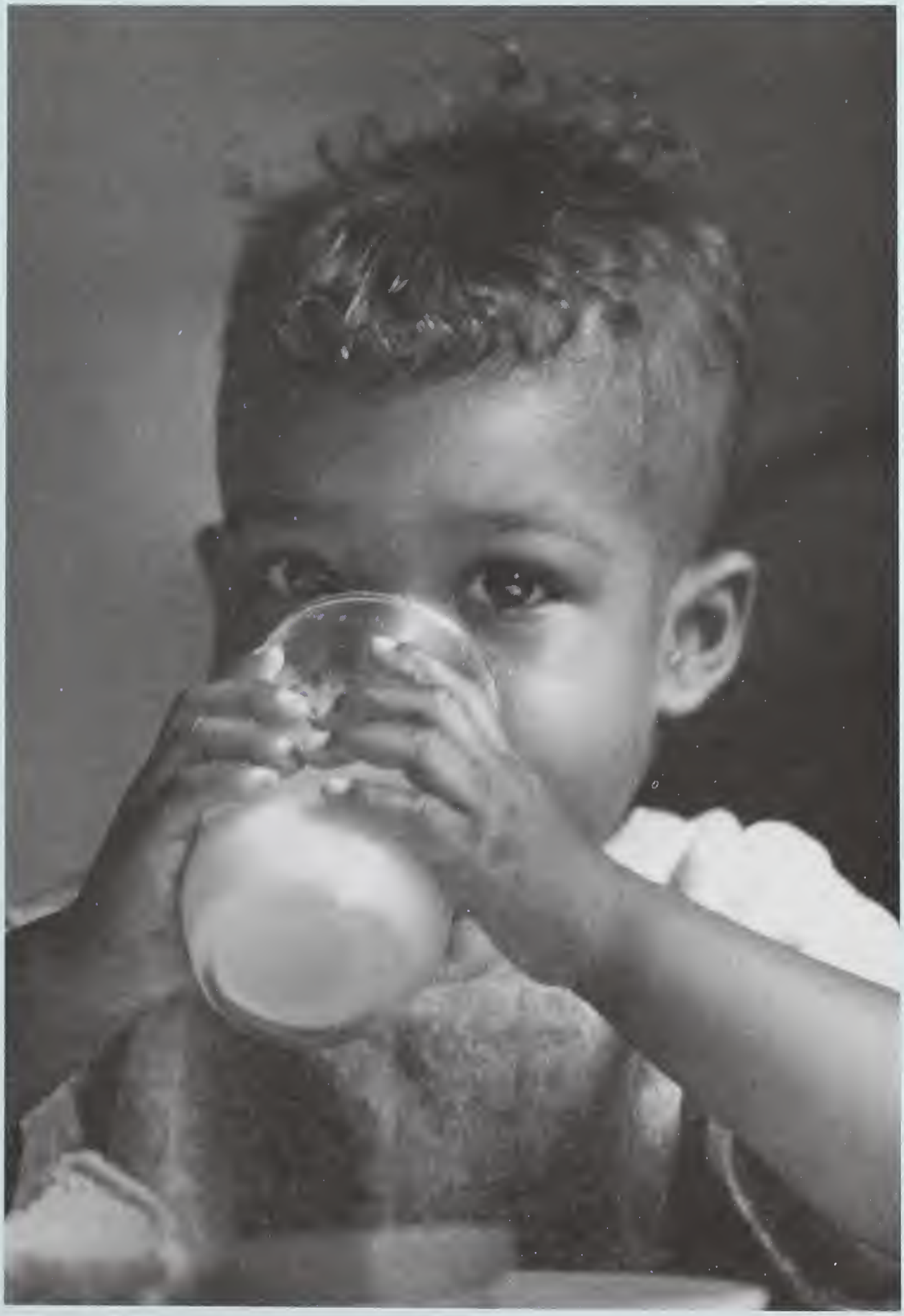
Lilly, T., Jr., Rhodehamel, E.J., Kautter, D.A., and Solomon, H.M. *Clostridium botulinum* spores in corn syrup and other syrups. **J. Food Protection** 54: 585-587, 1991.

Seigel, R.K. Herbal intoxication: psychoactive effects from herbal cigarettes, tea and capsules. **JAMA** 236:473, 1976.

Walton, J.L. and Messer, L.B. Dental caries and fluorosis in breast-fed and bottle-fed children. **Caries Res.** 15: 124-137, 1981.

Wilson, J.K. Nitrate in foods and its relation to health. **Agronomy J**. 41:20, 1949.

Winter, G.B., Rule, D.C., Mailer, G.P., James, P.M.C., and Gordon, P.H. The prevalence of dental caries in pre-school children aged 1 to 4 years. **Br. Dent. J.** 130: 271-277, 1971.



Special Concerns in Infant Feeding

Oral Health

Good nutrition, use of proper feeding techniques, and careful attention to keeping the mouth and teeth clean are all important for assuring that an infant develops and maintains healthy, strong teeth. This section reviews the subjects of tooth development, dental caries, nursing bottle caries, dental care for infants, and teething. Refer to pages 15-16 for information on fluoride supplementation for infants, as related to preventive dental care. Refer to chapter 7, pages 145-146, for counseling points related to oral health.

Tooth Development

The primary teeth and many permanent teeth begin forming inside the jawbones before birth. The primary teeth, which erupt over the first $2^1/_2$ years of the infant's life, are important as are the permanent teeth that follow. The primary teeth are critical for the chewing and eating of food, normal development of the jaw bones and muscles, proper placement of the permanent teeth, the appearance of the face, and proper speech development. The first primary teeth to erupt are the central and lateral incisors (the front four teeth on the lower and upper sections of the mouth). The first teeth may erupt beginning about 6 months old or later. Since the primary teeth are not fully replaced by permanent teeth until a child is 12 to 14 years old, keeping them healthy and intact during that period is of particular importance.

The nutrients necessary for proper tooth development include protein, and the minerals, calcium, phosphorus, and fluoride. Protein provides the foundation for the teeth and the minerals are deposited in this foundation to form a hard tooth structure. Fluoride, when incorporated during tooth development and after the teeth erupt, makes tooth enamel significantly more resistant to the acid attack that produces dental caries. Thus, a nutritionally adequate diet, along with adequate fluoride, is important for both the development and maintenance of healthy, strong teeth. Yet, even if a nutritious diet is consumed, as soon as any of the primary teeth begin to appear, they can decay under certain conditions.

Dental Caries (Tooth Decay)

Four factors need to be present in order for dental caries to occur—susceptible teeth, specific bacteria in the mouth, consumption of fermentable carbohydrates (sugars and starches), and time. Tooth decay begins when fermentable carbohydrates from food or beverages are metabolized by bacteria in the mouth, primarily *Streptococcus mutans (S. mutans)*, to organic acids. The *S. mutans* bacteria that normally live in the mouth adhere to the tooth surfaces and form dental plaque, the sticky, colorless material which accumulates around and between the teeth and gums and in the pits and grooves of the chewing surfaces of the teeth. The sticky plaque enables the bacteria and the acids they produce to remain on the tooth surface instead of being washed away by saliva. The longer plaque is allowed to stay undisturbed on the tooth surfaces, the greater is the likelihood that the bacteria will produce acids from carbohydrates. The acids demineralize or destroy the enamel on teeth and create dental caries.

If any of the primary teeth are lost prematurely to decay, surrounding teeth can move into the empty space. Then, permanent teeth may erupt not having sufficient room to be placed properly. They will then come in crooked, making them more difficult to clean and thus more susceptible to decay. Proper feeding practices, appropriate fluoride intake, and regular care of an infant's teeth help to prevent dental caries from occurring.

There is some evidence that *S. mutans* can be transferred from mother to infant or child (primarily through shared eating utensils or toothbrushes) and may increase the risk of the child developing dental caries (Ripa, 1988). The risk is increased if a mother has untreated dental caries. For this reason, it is advisable for mothers to:

- Avoid sharing eating utensils or toothbrushes with their infants or children;
- Avoid chewing food themselves and then feeding it to their infants;
- Take care of their mouths with regular toothbrushing, flossing, and dental care; and
- Obtain treatment for any existing dental caries.

Nursing Bottle Caries (Baby Bottle Tooth Decay)

Nursing bottle caries (baby bottle tooth decay) is a specific form of severe tooth decay of an infant's primary teeth. *Severe dental caries of this type are characterized by these distinguishing features* (Ripa, 1988):

- Many teeth are involved;
- The development of the decay is rapid; and
- The decay occurs on surfaces generally considered to be at low risk to decay. In the case of nursing bottle caries, the decay is usually seen on the four maxillary incisors (the upper four front teeth)—these teeth are among the first to erupt and are bathed in liquids first while the lower teeth are protected in part by the infant's tongue. As the decay progresses, these teeth become brown or black and may be completely destroyed. If inappropriate practices continue, the other teeth may also undergo similar decay after they erupt.

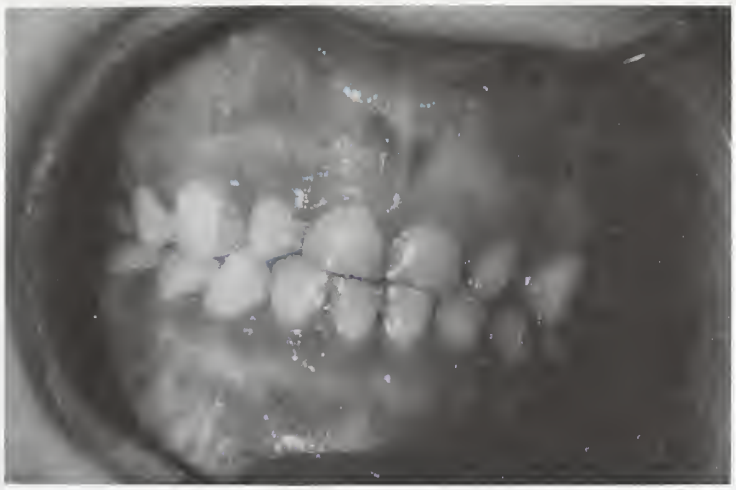
Nursing bottle caries develop when an infant's or child's teeth are bathed in liquids containing fermentable carbohydrates (such as infant formula, other milks, fruit juice, sweetened water, or other sweetened beverages) for prolonged periods of time during the day or night. Taking a bottle of these liquids to bed promotes caries development even more so because of decreased cleaning movements of the tongue and lower production of saliva (resulting in reduced cleansing of the teeth) during sleep.

See figure 10, page 115 for an illustration of healthy teeth and examples of an early stage of decay and severe tooth decay typical in cases of nursing bottle caries.

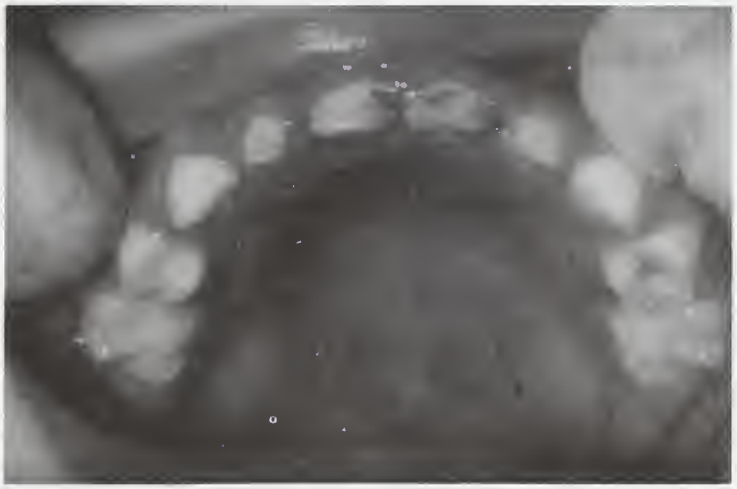
Prevention of Dental Caries and Nursing Bottle Caries

To prevent nursing bottle caries and caries development in general, these steps are recommended:

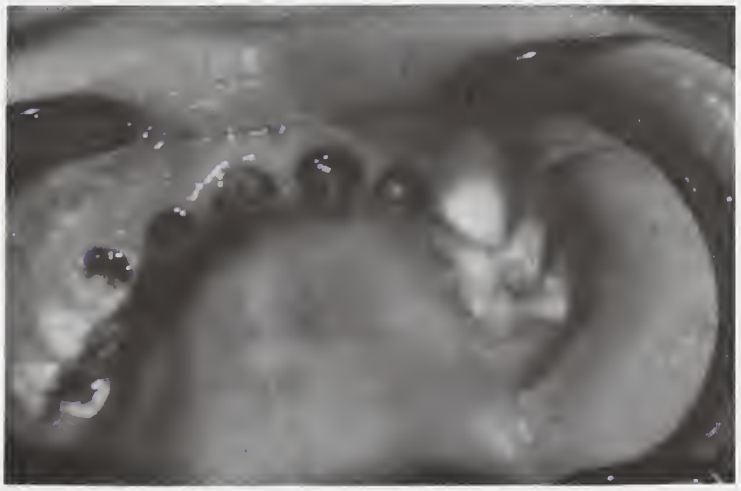
- Use bottles only for feeding infant formula, expressed breast milk, or a small amount of water (see guidelines on page 98 on feeding water). Do not feed juice or sweetened beverages in a bottle.
- Feed fruit juice only in a cup. Drinking from a cup will be messy at first. Be patient and allow the infant to learn this skill.
- Feed bottles of infant formula or breast milk to the infant only at feeding time, not when going to bed to sleep or for a nap. If an infant should fall asleep during a feeding, move the infant around slightly to stimulate swallowing before putting him or her down to sleep.
- Do not feed sweetened beverages to infants in either a bottle or a cup. These beverages include water sweetened with honey, sugar, or corn syrup; soda pop; sweetened iced tea; fruit drinks, punches, or aides; sweetened gelatin or other sweetened drinks. Infants should instead be fed nutritious beverages that will help them grow, such as breast milk or infant formula (water and fruit juice can be fed, but in small amounts). If your infant is having diarrhea, contact your health care provider for advice on what to feed to eat and drink.
- Do not leave a bottle in the infant's crib or playpen.
- Do not allow the infant to walk around or sit alone with a bottle for extended periods.
- Avoid feeding the infant concentrated sweet foods, such as lollipops, sweet candies, candy bars, sweet cookies or cakes, or sweetened cereals, or adding sweeteners to the infant's food.
- Never give the infant a pacifier dipped in honey, syrup, sugar, or other sweetened substance.
- Gradually begin shifting bottle feedings to cup feedings any time between 6 and 12 months old. As an infant advances from a bottle to a cup, the infant's chances of developing nursing caries are reduced. Strongly encourage caregivers of normal infants to wean their infants from a bottle to a cup by about 1 year old. Studies show that children still feeding from a bottle beyond 12 months may be at risk for nursing bottle caries (Fass, 1962; Winter et al., 1971; Walton and Messer, 1981).
- Follow the advice of your medical or dental health care provider regarding the infant's fluoride needs.
- Clean the infant's teeth regularly (as indicated below).



Healthy Teeth



Early Stage of Decay



Severe Decay

Figure 10: Illustration of Healthy Teeth and Tooth Decay Typical in Cases of Nursing Bottle Caries (Credit for these photographs is found on page188).

The best approach to help a caregiver improve or correct improper bottle feeding practices is to offer practical alternatives. For example, if an infant has become accustomed to a bottle in bed or a sweetened pacifier, suggest that the caregiver:

- Demonstrate love for her child, not with the bedtime bottle or sweetened pacifier, but rather by using a security blanket or teddy bear, singing or playing music, holding or rocking her child, or reading a story to her child (Phillips and Stubbs, 1987);
- Shift a bedtime bottle to 1 hour before the bedtime or naptime; and/or
- Give a plain pacifier only.

Caring for an Infant's Mouth and Teeth

Because the primary teeth are susceptible to decay as soon as they erupt, it is essential that care of the teeth and gums begin in early infancy.

The following steps are recommended to keep the teeth clean and prevent dental caries (AAPD, 1990; AAP, 1993; Goepferd, 1986; Nowak and Crall, 1988; Griffens and Goepferd, 1991):

- **Before teeth appear**

  Clean the infant's mouth beginning from the first day of life, even before teeth erupt. Wipe out the mouth gently and massage the gums with a clean damp gauze pad or washcloth after feedings or at least twice a day, including before bedtime. More frequent cleaning than twice a day may be recommended by a health care provider.

- **Once teeth appear**

  - Begin cleaning the infant's teeth as soon as they appear through the gums. Thoroughly clean the teeth after each feeding or at least twice a day, including before bedtime. More frequent cleaning than twice a day may be recommended by a health care provider, especially if there are beginning signs of tooth decay.
  - To clean the teeth, a very small, child-size toothbrush with soft, rounded-end bristles may be used with extreme care. Use water only, not toothpaste since an infant will swallow it. Continue using a clean gauze pad or washcloth to clean those areas in the mouth without teeth.
  - Infants with teeth can be fed a small amount of water to drink after meals to clean away food particles from the mouth.

Dental Care

To assure that any dental problems are discovered and treated before becoming serious problems, the American Academy of Pediatric Dentistry recommends that infants be taken for their first dental visit within 6 months of the eruption of the first primary tooth and definitely no later than 1 year old (AAPD, 1991). If a dentist is not available or accessible, a medical health care provider can examine the infant's teeth for problems. *During early dental checks, a dentist or medical health care provider can:*

- Examine the teeth for decay;
- Detect and prevent feeding habits which may contribute to dental problems; and
- Teach the caregiver proper dental care practices.

Infant dental checks should be seen as the beginning of a life of regular dental care that prevents a child from experiencing the negative effects of dental disease. If an infant or child seems to have dental problems or decay at any time, refer him or her to a medical or dental health care provider as soon as possible. If left untreated, dental caries can become very serious, possibly requiring the extraction of teeth at a very early age.

Teething

Teething occurs when the primary teeth are erupting and an infant has sore or tender gums as a result. Caregivers may notice that, during teething, the infant's gums are red and puffy, and may see or feel the emerging tooth. *Some methods of alleviating an infant's discomfort when teething include:*

- Chilling a clean favorite rattle, teething ring, pacifier, or a spoon in the refrigerator and offering it to the infant to chew on; and

- Cleaning the infant's mouth 2 to 3 times per day with a damp clean gauze pad or washcloth.

It is not recommended to give infants hard, raw vegetables like carrots or ice chips to chew on (they can choke on these), or to rub brandy or other alcoholic beverages on the teeth. Even small amounts of an alcoholic beverage can have adverse effects on infants. It is not advisable to give infants teething pain relief medicine before mealtime because it may interfere with chewing.

Sources of Educational Materials on Oral Health for Infants and Young Children

Resource materials on oral health for infants and young children can be obtained from:

- American Dental Association, 211 East Chicago Avenue, Chicago, IL 60611;
- Chief Dental Officer, Maternal and Child Health Bureau, Health Resources and Services Administration, Department of Health and Human Services (DHHS), Parklawn Building, 5600 Fishers Lane, Rockville, MD 20857;
- Division of Oral Health, National Center for Preventive Services, Centers for Disease Control and Prevention, DHHS, 1600 Clifton Road, N.E., Atlanta, GA 30333;
- Dental divisions of State and local departments of health; and
- Area schools of dentistry and dental hygiene.

Vegetarian Diets

Families or individuals choose to be on vegetarian diets for religious, philosophical, economic, ecological, health, or personal reasons. A vegetarian diet is generally defined as a diet which includes primarily or only plant foods (fruits, vegetables, legumes, nuts and seeds, and grains) and excludes certain or all animal foods (meats, poultry, fish, eggs, and dairy products). See the box above right for the various classifications of vegetarian diets.

Classification of Vegetarian Diets

Vegetarian diets have been classified into the following subdivisions, based on the types of animal foods included in the diet:

- **Lacto-vegetarian diet**—includes plant foods and dairy products.
- **Lacto-ovo-vegetarian diet**—includes plant foods, dairy products, and eggs.
- **Semi-vegetarian diet**—includes plant foods and may include dairy products, eggs, fish, and/or poultry.
- **Vegan diet**—includes plant foods only and no animal foods at all. (This diet can place an infant's health and nutritional status at significant risk, especially if the diet is poorly planned.)
- **Zen Macrobiotic diet**—includes unpolished rice and other whole grains, legumes, seaweed, fermented foods, nuts and seeds, vegetable oils, fruits and vegetables, and usually fish; this diet includes various stages of much more severe dietary restriction which exclude some of these foods. Generally, dairy products, red meat, and poultry are excluded from this diet. (These diets can be dangerous to the health of infants and children.)
- **Fruitarian**—includes fruits, nuts and seeds, fermented cereals, olive oil, and honey. (This diet can be very dangerous to the health of infants and children.)

Within each classification, there may be variations as to the foods eaten.

Most infants are on a lacto-vegetarian diet during the first 4 to 6 months of life, with no risk to their health. Further, a well-planned vegetarian diet, that includes some animal foods, can provide the older infant with adequate levels of nutrients needed for growth and development. Studies show that children on varied vegetarian diets, which include some animal products (e.g., dairy products and/or eggs), grow normally (Dietz and Dwyer, 1981; Dwyer et al., 1982).

Risks of Some Vegetarian Diets

As vegetarian diets become more restrictive, the greater the nutritional and health risks to the infant. Infants of any age on a restrictive vegetarian diet, such as a vegan, macrobiotic, or fruitarian diet, are placed at significant risk for growth abnormalities and serious nutritional deficiencies and health problems (Fulton et al., 1980; Sanders and Purves, 1981; Truesdell and Acosta, 1985; Shull et al., 1977; Dagnelie et al., 1990; Robson et al., 1974). Inadequate vegetarian diets may lead to failure to thrive, iron deficiency anemia, megaloblastic anemia due to lack of vitamin B_{12}, (which is often masked by high folic acid levels but which may lead to eventual neurologic problems), and vitamin D deficiency rickets (Jacobs and Dwyer, 1988). In working with caregivers of infants on restrictive vegetarian diets, it is appropriate to:

- Inform the caregivers about the limits and potential detriments of the restrictive diets;
- Discourage use of very restrictive vegetarian diets;
- Refer the infant to a health care provider for a medical evaluation and advice on supplementation if the caregiver decides to keep the infant on a restrictive diet; and
- Provide nutrition assessment and initial and followup nutrition counseling (if a caregiver decides to keep his or her infant on a vegan diet, see figure 11, page 121, for recommended daily food servings for a 6- to 12-month-old vegan infant).

Guidelines for Nutrition Counseling

In providing nutrition counseling to caregivers of infants on vegetarian diets, these guidelines are recommended:

1. Assess the diet for adequacy, including nutritional deficiencies and/or excesses, and to determine if the diet is appropriate for the infant's developmental level.

2. Discuss with the caregiver the appropriate amounts and types of foods needed to supply adequate energy, protein, vitamins, and minerals. Be mindful that the dietary preferences of vegetarian clients may be based on deeply held beliefs and cultural food habits. Work with the caregiver at initial and followup nutrition counseling sessions to assure that the diet is nutritionally adequate. Adequacy of these nutrients should be evaluated closely:

- **Energy content**
  Since many vegetable and cereal-based foods have a low-energy and high-fiber content, an infant's foods need to be chosen wisely to assure that sufficient kilocalories and nutrients can be consumed daily. Although a small amount of fiber in an infant's diet should not be harmful, a high-fiber diet tends to fill an infant's stomach and limit the amount of foods which the infant can physically consume during meals. A high-fiber diet can also reduce the availability of the minerals, iron, calcium, and zinc from foods in the diet (Dwyer, 1993). Thus, encourage caregivers to select a variety of foods, including those with a moderate- or low-fiber content (e.g., cheese, yogurt, tofu).

- **Protein**
  The protein needs of a lacto- or lacto-ovo-vegetarian infant are easily met if the diet includes sufficient quantities of high quality protein foods (e.g., yogurt, cheese, egg yolks). A vegan diet must be planned carefully to ensure that a sufficient quality and quantity of protein is provided. Advise caregivers, who decide to keep their infants on a vegan diet, to:

  - Breastfeed or consult with their health care provider regarding the use of commercial soy-based infant formula. Commercial soy-based infant formulas are nutritionally balanced. Soy beverages (sometimes described as soy drinks or soy milks), sold in grocery and specialty food stores, are grossly lacking in key nutrients needed by infants (calcium, niacin, vitamins D, E, and C) and should not be fed as substitutes for infant formula; and
  - For infants over age 6 months, feed combinations of plant foods during the course of each day (see page 6 on plant protein).

  Combinations of plant foods to eat during the day to meet the protein needs of the older vegetarian or vegan infant include:

- Cooked mashed tofu and ground or mashed rice;
- Iron-fortified infant cereal and commercial soy-based infant formula;
- Cooked pureed kidney beans with ground or mashed rice, mashed noodles, or a piece of whole-wheat bread; and
- Other combinations of different legumes and cereal grains (e.g., rice, wheat, barley) prepared with the appropriate texture.

Vitamin B_{12}

Since vitamin B_{12} is only found in animal foods and some obscure food sources (e.g., nutritional yeast), infants who do not consume animal foods or vitamin B_{12}-fortified foods can develop a deficiency in this vitamin. Thus, assess the diet of any vegetarian infant to determine whether sources of vitamin B_{12} are included, either from infant formula or indirectly in the diet of the infant's lactating mother.

Advise caregivers who decide to keep their infants on a vegan diet to breastfeed or consult with their health care provider regarding the use of commercial soy-based infant formula. Since the vitamin B_{12} content of breast milk is influenced by the nursing mother's diet, a B_{12} deficiency can develop in an exclusively breastfed infant whose mother is on a vegan diet. Thus, it is advisable for the vegan nursing mothers to consume vitamin B_{12}-fortified foods or take a supplement containing vitamin B_{12} to ensure that their breast milk has adequate vitamin B_{12} stores. If a mother provides breast milk deficient in this vitamin to an exclusively breastfed infant for a period of time, the infant could develop neurological damage.

Refer the infant and/or mother to a health care provider for assessment if it appears that the infant's intake of vitamin B_{12} may be compromised.

Vitamin D

See pages 8-9 for more information on the vitamin D needs of breastfed infants. The vitamin D needs of a lacto- or lacto-ovo-vegetarian infant can easily be met if the diet includes vitamin D sources, e.g., commercial infant formula, eggs, fortified cow's milk products, and butter. Vitamin D can also be obtained from exposure to the sun, fatty fish, fortified margarine, or cod liver oil. A vegan infant who is not exposed to the sun and does not receive soy-based infant formula, a vitamin D supplement, or the other foods high in this vitamin is at risk for developing a vitamin D deficiency and rickets.

Encourage caregivers who decide to keep their infants on a vegan diet to breastfeed and, if the infant has dark skin or may not be receiving regular exposure to sunlight (at least 30 minutes of exposure per week if wearing only a diaper, or 2 hours per week if fully clothed without a hat), consult with their health care provider about vitamin D supplementation. Alternately, a health care provider can be consulted regarding the use of commercial soy-based infant formula.

Calcium

Calcium needs are easily met if an infant is consuming adequate quantities of breast milk or commercial infant formula, both rich sources of calcium. Calcium, in smaller amounts and a less available form, is also in soybeans and other legumes, grain products, and dark green leafy vegetables (including chard, kale, greens, spinach). If a caregiver decides to keep a nonbreastfed infant on a vegan diet, refer the infant to a health care provider regarding the use of commercial soy-based infant formula and for advice on supplementation if necessary.

Iron

Most full-term infants are born with iron stores that are not depleted until about 4 to 6 months old. A vegetarian infant who consumes an appropriate amount of iron-fortified infant formula daily and iron-fortified cereal starting between 4 and 6 months should receive an adequate amount of iron in the first year of life. Alternate sources of iron need to be provided to infants age 6

months or older who are exclusively breastfed. See page 13 for more information on iron for breastfed and formula-fed infants. Iron sources, besides meat, poultry, and fish, include iron-fortified infant cereal and other enriched and whole-grain products, cooked dried beans and peas, and cooked dried fruits. Since these plant foods contain poorly absorbed nonheme iron, it is recommended to feed vitamin C-rich foods (see pages 10 and 165 for examples) at the same meal with those foods to increase iron absorption. Refer infants who may be iron-deficient, based on dietary intake or hematological tests, to a health care provider for assessment, monitoring, and advice on supplementation.

- **Zinc**
  Breast milk or commercial infant formula consumed in appropriate amounts provide sufficient zinc for young infants. After 6 months old, food sources of zinc should be added to the diet. Zinc sources, besides meat, poultry, fish, and eggs, include fortified or whole-grain cereals and other grain products, cheese, yogurt, legumes and, wheat germ (which should be mixed into other foods because it can cause choking if eaten dry).

- **Riboflavin (vitamin B_2)**
  Dairy products are one of the major sources of riboflavin in an infant's diet. Infants who are not fed breast milk, commercial milk-based infant formula, or other dairy products can obtain riboflavin from commercial soy-based infant formula, enriched, fortified, and whole-grain breads or cereals, dark green leafy vegetables, legumes, broccoli, and avocado.

3. Emphasize the importance of following general guidelines on how to introduce new foods (see page 90) and of watching for hypersensitivity (allergic) or other reactions that an infant may have to new foods.

4. Discuss with the caregiver the importance of modifying the texture of foods to meet the infant's needs. Some foods commonly included in vegetarian diets may be coarse and hard to digest and/or may require teeth for chewing. Guidelines to make certain foods suitable for infants include:

   - Puree or mash cooked whole dried beans and peas.
   - Grind up or finely mash cooked whole grain kernels, such as rice, wheat berries, barley, etc. Avoid these grain products that require chewing and can cause choking: granola-type cereals, cooked whole grain kernels, and plain, dry wheat germ.
   - Do not feed whole or chopped nuts and seeds to infants or young children. Discourage the use of nut/seed butters because they can stick to the roof of the mouth possibly causing choking and may cause hypersensitivity (allergic) reactions (see pages 90-91 for more information on these reactions). However, if caregivers insist on using these butters, it is advisable that they (CDA and SSDA, 1992) :

     - Delay feeding nut/seed butters until at least after the 9th month of age;
     - Only use smooth plain nut/seed butters and always mix them with liquid (i.e., water, infant formula, or breast milk) into a slurry to make them easier to swallow and to reduce the risk of choking;
     - **Never** feed the infant commercial honey-peanut butter mixtures (or any honey-containing food products) because of the danger of infant botulism (see page 98); and
     - Watch carefully for reactions to these nut/seed-based foods.

   - Follow standard recommendations regarding home preparation of fruits, vegetables, and grains for infants (see chapter 5 for more information on home preparation of baby food).

If the above concerns are appropriately addressed when feeding a vegetarian infant, it should be possible for the infant to receive an adequate balance of nutrients and, thus, achieve optimum growth and development.

Figure 11. Recommended Daily Food Servings for a 6- to 12-Month-Old Vegan Infant

Food Category	Approximate Amount Recommended Per Day
From 6 to 12 months old	
Breast milk **or** **Soy-based infant formula**	4 to 6+ feedings 27 to 32 ounces
Cereals include: – Fortified Infant cereal – *Finely ground* cooked grains, e.g.: • brown rice • millet • enriched rice • barley • bulgur • noodles/macaroni • wheat berries (watch for reactions to wheat) *Avoid: granola, plain dry wheat germ, or unground whole grain kernels (can cause choking)*	4 to 8 Tbs. infant cereal 1+ Tbs. of other grains
Fruits include: – strained and junior fruits – cooked fresh fruits – mashed ripe peeled fruits (like bananas, peaches, nectarines) – fruit spreads (e.g., made from cooked apples, or dried peaches or apricots)	4 to 8 Tbs. fruit
Vegetables include: – strained and junior vegetables – cooked and pureed vegetables, preferably dark green and orange vegetables, such as: • sweet potatoes • green beans • broccoli • green peas • carrots	4 to 8 Tbs. vegetables
Juices include: – 100 percent fruit or vegetable juices (only from a cup)	2 to 4 oz. fruit or vegetable juice
Protein-rich Foods include: – cooked, pureed or mashed, and sieved beans and peas – Avoid feeding nut/seed butters. If the caregiver insists on feeding the infant these butters, should delay until at least after the 9th month and make sure to: • watch carefully for reactions, • use only smooth, not chunky types, and • dilute with water, breast milk, or formula so that the infant does not choke. *Do not feed infants any whole or chopped nuts or seeds, or any peanut butter with honey (honey should **never** be fed to infants).*	2 to 12 Tbs. protein-rich foods (amount depends on age and appetite)
Can add at 8 months of age:	
Bread/Crackers include: – whole-grain and enriched breads – whole-grain and enriched crackers – tortillas, pocket bread	1 to 2 slices bread 1 to 2 crackers

This figure is adapted from chart in: Truesdell D.D. and Acosta P.B.: Feeding the vegan infant and child. © The American Dietetic Association. Reprinted with permission from the JOURNAL OF THE AMERICAN DIETETIC ASSOCIATION, Vol. 85:837-840, 1985.

Common Gastrointestinal Problems

Spitting Up and Vomiting

It is normal for young infants to spit up a small amount of breast milk or formula after feedings. The muscle located between the stomach and the esophagus may not be sufficiently developed to keep all the food in an infant's stomach after eating. Usually about a teaspoon or less of breast milk or formula will come out of an infant's mouth after feeding when the infant is burped or allowed to lie flat down on his or her side or back. It is generally recommended that an infant be placed on his or her side or back to sleep or rest, unless there is a medical reason to do otherwise (AAP, 1992). But, caregivers of infants with gastroesophageal reflux should discuss the infant's sleeping position with their health care provider. Gastroesophageal reflux** is defined as the spontaneous, effortless regurgitation of material from the stomach into the esophagus (Rudolph et al., 1991).

Methods to reduce excessive spitting up include:

- Burping the infant several times during a feeding. Burping is generally done during normal breaks in a feeding; it slows a feeding and can lessen the amount of air swallowed (see pages 47 and 76 on burping);
- Holding the infant in an upright position after a feeding for about 10 to 15 minutes;
- Avoiding excessive movement or play right after eating; and
- Not forcing the infant to eat or drink when full and satisfied.

Vomiting refers to the forceful discharge of food through the esophagus and involves a more complete emptying of the stomach's contents. Vomiting can occur as a symptom of a reaction to food eaten, a minor or major medical condition, or use of certain medications. Vomiting can result from stimulation to the inner ear from being in a moving vehicle, or even from excitement or nervousness. Vomiting can place an infant at risk of dehydration (see signs of dehydration, page 18).

Refer an infant to a health care provider for medical evaluation if the caregiver notes that the infant is vomiting or that his or her spitting up is unusual in terms of volume, contents, or accompanying symptoms.

Diarrhea

Diarrhea is defined as the frequent passage of loose, watery stools. Diarrhea should not be confused with the normal stools of breastfed infants (see page 52). Diarrhea in infants can be caused by a reaction to a food, excessive juice consumption, use of certain medications, medical conditions or infections, malabsorption of food, or consuming contaminated food or water. Proper formula preparation techniques are very important in assuring that formula is not contaminated and a potential cause of diarrhea.

If untreated, diarrhea in an infant can rapidly lead to dehydration which can be life-threatening. Chronic diarrhea may lead to nutrient deficiencies because food passes through the gastrointestinal tract too quickly to be digested and nutrients cannot be absorbed. Thus, refer an infant to a health care provider for medical evaluation if the caregiver notes that the infant is having diarrhea. Caregivers should consult with the infant's health care provider about the treatment of diarrhea and not self-treat diarrhea by feeding ordinary beverages such as carbonated beverages, coconut water, fruit juice, tea, chicken broth (Hendricks and Walker, 1990; Snyder et al., 1990). Use of ordinary beverages to treat diarrhea may actually worsen the condition and lead to further dehydration. Depending on an infant's condition, a health care provider may prescribe an appropriate oral rehydration solution to prevent and treat dehydration resulting from diarrhea. Oral rehydration solutions should be used only under the supervision of physicians or other trained health personnel (CON, 1993).

***Infants with gastroesophageal reflux who have wheezing, recurrent pneumonia or upper respiratory infections, symptoms of esophagitis, an irritation of the esophagus (e.g., irritability during feeding), or failure to thrive, are at particular risk and should be referred to a health care provider immediately.*

Constipation

Constipation is generally defined as the condition when bowel movements are hard, dry, and passed with difficulty. Although some believe that constipation is related to the frequency or the passage of stools, this may not be as important as the consistency of the stools. Part of the difficulty in determining whether an infant is constipated is that each caregiver may have a different perception of how often an infant should have a bowel movement and whether an infant's stool is "too hard." True constipation is not very common among breastfed infants who receive adequate amounts of breast milk or formula-fed infants who consume adequate diets.

See page 52 on stool differences between breastfed and formula-fed infants. Formula-fed infants tend to have firmer stools, but this does not indicate constipation.

Constipation can be caused by a variety of factors or conditions, including:

- Dietary influences, such as:
  - inadequate breast milk, formula, food, or fluid intake;
  - improper dilution of formula;
  - early introduction of solids; or
  - excessive cow's milk in older infants.
- Abnormal anatomy or neurologic functioning of the digestive tract;
- Use of certain medications;
- A variety of medical conditions and hormonal abnormalities;
- Stool withholding due to rectal irritation from thermometers, vigorous wiping, etc.;
- Excessive fluid losses due to vomiting or fever;
- Lack of movement or activity; or
- Abnormal muscle tone.

If a caregiver complains that an infant is constipated, refer the infant to a health care provider for medical evaluation. If the health care provider determines that the infant's diet is inappropriate and a factor influencing the constipation, it is appropriate to assess the infant's diet, with particular focus on:

- The adequacy of intake of breast milk or infant formula;
- Proper formula preparation and dilution if formula-fed;
- Whether appropriate types of solid foods are consumed (see figure 9, pages 108-109 for guidelines on introducing foods); and
- Premature introduction of solid foods if the infant is less than 4 months old.

References

AAP (American Academy of Pediatrics) Task Force on Infant Positioning and SIDS. Positioning and SIDS. **Pediatrics** 89: 1120- 1126, 1992.

AAPD (American Academy of Pediatric Dentistry). **Your Baby's Smile: A Guide to Infant Oral Health from the American Academy of Pediatric Dentistry.** Chicago, IL: American Academy of Pediatric Dentistry, 1990.

_____. **American Academy of Pediatric Dentistry Manual, 1991-1992.** Chicago, IL: American Academy of Pediatric Dentistry, 1991.

CDA and SSDA (Chicago Dietetic Association and the South Suburban Dietetic Association). **The Manual of Clinical Dietetics**. Chicago, IL : The American Dietetic Association, 1992.

CON (Committee on Nutrition), American Academy of Pediatrics. **Pediatric Nutrition Handbook.** 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1985.

_____. **Pediatric Nutrition Handbook.** 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics, 1993.

Dagnelie, P.C., Vergote, F.J.V.R.A., Staveren, W.A. van, Berg, H. van den, Dingjan, P.G., and Hautvast, J.G.A.J. High prevalence of rickets in infants on macrobiotic diets. **Am. J. Clin. Nutr.** 51: 202-208, 1990.

Dietz, W.H. and Dwyer, J.T. Nutritional implications of vegetarianism for children. In: Suskind, R.M. (ed.). **Textbook of Pediatric Nutrition.** New York, NY: Raven Press, 1981.

Dwyer, J.T., et al. Nutritional status of vegetarian children. **Am. J. Clin. Nutr.** 35: 204, 1982.

Dwyer, J.T. Vegetarianism in children. In: Queen, P.M. and Lang, C.E. **Handbook of Pediatric Nutrition.** Gaithersburg, MD: Aspen Publishers, Inc., 1993.

Fass, E.N. Is bottle feeding of milk a factor in dental caries? **J. Dent. Child.** 29: 245-251, 1962.

Fulton, J.R., Hutton, C.W., and Stitt, K.R. Preschool vegetarian children. **J. Am. Diet. Assoc.** 76: 360, 1980.

Goepferd, S. J. Infant oral health: a protocol. **J Dent Child.** 53: 261, 1986.

Griffens, A.L. and Goepferd, S.J. Preventive oral health care for the infant, child, and adolescent. **Pediatr. Clin. North Am.** 38: 1209-17, 1991.

Jacobs, C. and Dwyer, J.T. Vegetarian children: appropriate and inappropriate diets. **Am. J. Clin. Nutr.** 48: 811-818, 1988.

Nowak, A. and Crall, J. Prevention of dental disease. In: Pinkham, J.R., ed. **Pediatric Dentistry, Infancy Through Adolescence.** Philadelphia, PA: W.B. Saunders Co., 1988.

Phillips, M.G. and Stubbs, P.E. Head Start combats baby bottle tooth decay among Native American families. **Children Today.** 16:25-28, 1987.

Ripa, L.W. Nursing caries: A comprehensive review. **Pediatr. Dent.** 10: 268-282, 1988.

Robson, J.R.K, Konlande, J.E., Larkin, F.A., et al. Zen macrobiotic dietary problems in infancy. **Pediatrics** 53: 326, 1974.

Rudolph, A.M., Hoffman, J.I.E., Rudolph, C.D., and Sagan, P. (eds.). **Rudolph's Pediatrics.** 19th edition. Norwalk, CT: Appleton & Lange, 1991.

Sanders, T.A.B. and Purves, R. An anthropometric and dietary assessment of the nutritional status of vegan preschool children. **J. Hum. Nutr.** 35: 349, 1981.

Shull, M.W., Reed, R.B., Valadian, I, Palombo, R., Thorne, H., and Dwyer, J.T. Velocities of growth in vegetarian preschool children. **Pediatrics** 60: 410, 1977.

Truesdell, D.D., and Acosta, P.B. Feeding the vegan infant and child. **J. Am. Diet. Assoc.** 85: 837-840, 1985.

Vyhmeiser, I.B., Register, U.D., and Sonnenberg, I.M. Safe vegetarian diets for children. **Pediatr. Clin. North Am.** 24: 203- 210, 1977.

Walton, J.L. and Messer, L.B. Dental caries and fluorosis in breast-fed and bottle-fed children. **Caries Res.** 15: 124-137, 1981.

Winter, G.B., Rule, D.C., Mailer, G.P., James, P.M.C., and Gordon, P.H. The prevalence of dental caries in pre-school children aged 1 to 4 years. **Br. Dent. J.** 130: 271-277, 1971.

Summary of Key Points in Previous Chapters

This chapter summarizes many of the key points on infant feeding which are covered in other chapters. This section can be used to plan topics to discuss in individual nutrition counseling sessions or group classes on infant feeding, or in developing nutrition education materials. This listing does **not** provide a summary of all the possible topics to cover with caregivers on infant nutrition and feeding. Further, it does **not** provide a summary of all the information covered in this handbook.

To best use this chapter in planning counseling sessions and classes, consider these points:

- Base topics to be covered at an individual counseling session on:
  - Nutrition education needs (desired knowledge, skills, and behaviors to be learned) identified through the nutrition assessment process and other sources (e.g., through consultation with auxiliary health care and other personnel providing care to the infant); and
  - The caregiver's expressed needs identified during the assessment.
- Carefully select the information covered, in individual or group sessions, to include a manageable number of the most important concepts.
- At followup individual counseling sessions with clients, check on progress from previous session; additional new important topics can be covered depending on the time available.
- Involve the client in planning any feeding and other changes to improve the infant's nutritional status and health. If possible, also involve other family members or friends if they have any impact on the feeding and care of the infant.
- Adapt the wording of the points covered to be conversational and to accommodate the needs, learning skills, cultural and ethnic background, and language ability of the caregiver.

Additional information on planning nutrition education sessions can be found in these FNS publications:

- "The WIC Exchange: Ideas to Help Nutrition Educators Help Clients," FNS-267, 1990.
- "Cross-Cultural Counseling: A Guide for Nutrition and Health Counselors," FNS-250, 1986.
- "The Idea Book: Sharing Nutrition Education Experiences," FNS-234, 1981.

Breastfeeding

Be Comfortable

- Find a place that is comfortable where you can relax while nursing.

When and How Long to Nurse Baby

- Nurse your baby often during the day and night to:
  - Allow your body to make enough milk for your baby (the more you nurse, the more milk your body makes);
  - Keep your breasts from storing too much milk; and
  - Help your baby grow.
- Hold, rock, or play with your baby when fussy or crying before concluding that it is time for a feeding. It is important to show love, comfort, and cuddling to your baby and talk to your baby during feedings but also between feedings.
- Nurse your baby when he or she is hungry (the baby may wake and toss, suck on a hand, cry or fuss, or look like he or she is going to cry to show hunger). Follow your baby's lead on when and how long to nurse.
  - From birth to 4 weeks old, breastfed babies generally nurse every $1\frac{1}{2}$ to 3 hours during the day and night. If your baby does not seem hungry, still try to nurse about every 3 hours. Wake your very young baby to nurse if he or she sleeps longer than 4 hours.
  - From 4 weeks to 6 months, breastfed babies nurse about every 2 to 4 hours (the baby may also sleep longer during the night).
  - From 6 to 12 months, breastfed babies nurse about every 4 to 6 hours.
- Do not limit how long you feed your baby. Encourage your baby to nurse as long he or she wants. Most babies nurse10 to 20 minutes on each breast, for a total of 20 to 40 minutes; but some babies may nurse for longer or shorter times.
- Allow your baby to nurse from the first breast as long as he or she desires. Offer the second breast. If the baby does not take the second breast, offer it first at the next feeding.

- If both breasts were used at a feeding, try to start feeding on the breast you finished with on the last feeding. You can place a safety pin on your clothing over the breast you intend to begin with for the next feeding as a reminder.

Burping

- Burp the baby if he or she pauses or comes off the breast, when switching to the second breast, and when the feeding is finished. Burping times also allow you to enjoy your baby by talking gently and smiling at him or her.
- Burp by gently patting or rubbing baby's back while he or she is held against the front of your shoulder and chest or held in a sitting position in your lap.

What Breast Milk Looks Like

- The first breast milk, called colostrum, is thick and yellow and contains antibodies that help fight diseases and are very healthy for the baby.
- The milk that comes in later looks more watery, is a bluish white color at the beginning of the feeding, and tends to look slightly yellow and thicker at the end of the feeding. This milk also contains important antibodies and is very nutritious for the baby. Sometimes the milk may be pale green, yellow, or orange if you eat certain foods.
- If you express the milk and let it sit, it is normal for the fat in it to separate and come to the top, and for there to possibly be small lumps of cream in it.

How the Breasts Feel

- During the first 1 to 2 weeks after birth, the breasts tend to swell. By the end of the second week the swelling may go down—this is natural and does not mean that you are losing your milk.

Attaching to and Coming off the Breast

- Wash your hands before starting to nurse.
- In attaching your baby to the breast, hold him or her close to you and rub the baby's chin or lower lip with the nipple. As the baby opens his or her mouth wide and the tongue is on the floor of the mouth, quickly bring the baby toward the breast and get the whole nipple and most of the dark circular part of the breast (the areola) into the baby's mouth. Hold the breast using a "C-Hold" (see figure 5, page 46).
- Babies often come off the breast on their own. But, if you want your baby to come off the breast, slide a little finger between the corner of the baby's mouth and the breast to gently break the suction between the two.

Nursing Positions

- You can try different positions to nurse your baby (this may help if sore nipples are a problem). Three different positions are shown in figure 3, page 43.

How to Know if Your Baby is Drinking Enough Milk

- *Your fully breastfed baby is likely drinking enough milk if he or she:*
  - Is gaining weight steadily even if slowly (this is a very important indicator); your health care provider can tell you if your baby is growing properly;
  - Nurses an appropriate number of times per day for his or her age (see pages 48 and 108-109);
  - Can be heard swallowing regularly while nursing (in a quiet room);
  - Wets the diaper to the point that you are changing about 6 to 8 very wet cloth diapers or 5 to 6 very wet disposable diapers in 24 hours (while not being given any extra fluids besides breast milk);
  - Wets the diaper with clear or pale yellow urine; and
  - Has many bowel movements each day during the first 6 weeks of life. Some babies have a bowel movement with every nursing; a baby who has fewer than 4 per day may not be consuming enough milk. After 6 weeks, the number of bowel movements can vary from less than once a day to many per day.

General Care of the Nipples

- After nursing, let the nipples air dry, then try to keep them dry and, if possible, allow them to be exposed to air and light (sunlight or sit under a 60-watt lightbulb) for a short time in between feedings; this reduces the chances of developing sore nipples. Some suggest expressing a few drops of breast milk on the nipples and allowing it to dry on the nipples to prevent sore nipples.
- If nursing pads or similar dry breathable cloths are used in the bra to collect leaking milk, make sure to change them if they become wet.
- If you are washing your nipples, try to wash them only with plain clean water. If soap or shampoo gets on them during a shower or bath, just rinse it off with plain water. Too much soap on the nipples washes off protective oils.
- Do not try to "toughen" the nipples by rubbing them with a towel or other cloth. This practice removes skin layers from the breast and irritates the nipples.
- Talk to someone trained in lactation management if dry nipples are a problem and before using creams, ointments, or oils on the nipples or areolae.

Alcohol, Cigarette Smoking, Caffeine, and Other Drugs

During the nursing period:

- Consult with a nutritionist for information on what to eat while you are nursing;
- Avoid drinking alcoholic beverages. If needed, ask clinic staff for information on services to help you drink less alcohol;
- Avoid drinking more than 2 cups of coffee (caffeinated or decaffeinated), hot chocolate, tea, or soft drinks containing caffeine (such as colas).
- If you smoke, try very hard to quit smoking.
- Your smoking harms your health and the health of your baby and children. Ask clinic staff for information on services to help you quit smoking. If you are unable to quit smoking, take these steps:
  - Cut down on the number of cigarettes smoked;
  - Try not to smoke for $2\frac{1}{2}$ hours before nursing your baby;
  - Do not smoke, during nursing and other times, around your baby (nicotine from the cigarette smoke enters your baby's system from the air—the smoke can make baby very sick); and
  - Refrain from smoking until right after a feeding so that nicotine levels will have time to decrease before the next feeding.
- Also, ask other smokers you know to avoid smoking around your baby or other children.
- Tell your health care provider that you are nursing and check with him or her before taking any drugs or medicines, even over-the-counter drugs like aspirin and cold medicines. Also, consult with your health care provider before taking any vitamin-mineral supplements.
- Avoid using any "street" (illegal) drugs. If you use street drugs, ask clinic staff for information on services to help you stop using drugs.

Feeding Water to Baby

- Fully breastfed babies generally do not need extra bottles of water or formula, unless recommended for medical reasons. Breast milk contains the amount of water that healthy breastfed babies need until they are eating a variety of solid foods (see page 143).

Pacifiers

- If you plan to fully breastfeed your baby, avoid using a pacifier for the first 2 to 4 weeks of your baby's life. This will make it easier for the newborn baby to learn to suckle properly on the breast in the early weeks.

Expressing Breast Milk

- Learn how to express your own breast milk. The milk can be expressed by hand or by using a mechanical or electric breast pump. Read the pump's instructions or ask someone trained in lactation management to show you how.
- *In preparing to express milk:*
  - Wash your hands first;
  - Express the milk by hand or using a very clean pump; and

- Collect the milk in a very clean container (plastic or glass containers are the best).

■ *In storing expressed milk:*

- Store bottles of breast milk in a properly working refrigerator or freezer after you collect the milk and until ready to use (the temperature of the refrigerator should be 40° Fahrenheit or below and the freezer should be 0° Fahrenheit or below; these temperatures can be checked using special thermometers for refrigerators and freezers). If either is not available (e.g., at work or school), the milk can be stored for a short time in a cooler packed with ice or an ice gel pack, until brought home for storage in a refrigerator.
- Use refrigerated bottles of milk within 48 hours from the time they were prepared.
- If planning to freeze breast milk, freeze it immediately in portions generally needed for a single feeding (e.g., 2- to 3-ounce portions for most infants less than 3 months old; 3- to 4-ounce portions for infants 3 to 5 months old; 4 ounces or more for infants 6 months and older). Some 1-ounce portions can be frozen for times when your baby wants some extra milk.
- Preferably, use clean glass or hard plastic bottles for storing and tightly cap them after filling. If using disposable nursing bags, double them to avoid breaking when frozen. When filling a bottle, leave room at the top (about 1 inch) for expansion.
- Clean used bottles and their parts using soap, hot water, and bottle and nipple brushes, and if your baby is less than 3 months old, sterilize those items by boiling them in water for 5 minutes or clean them in a dishwasher, as shown in figures 7a, b, and c, pages 80-82, before reusing.
- Frozen breast milk can be stored for up to 3 months in a properly working self-contained freezer unit attached to a refrigerator. If the freezer is not working or if there is a power failure, frozen milk may thaw out and become rancid and spoiled before 3 months. If frozen food in your freezer gets soft or begins melting, have your freezer checked.
- Label the container of milk for storage with the collection date. Use the oldest milk first.
- Once frozen breast milk is thawed, use it within 24 hours and do not refreeze it. Do not add warm milk to cold or frozen milk. Each time a liquid is added to frozen milk, a thin layer of milk thaws—germs can grow in this warmer layer.

■ *On traveling with expressed milk:*

- Store bottles of expressed breast milk in a cooler with ice or a cold pack while traveling.
- Do not travel with bottles of unrefrigerated milk kept at room temperature.

■ *To thaw and warm breast milk:*

- If your baby prefers a warmed bottle, warm the refrigerated bottle immediately before serving by holding it under running warm tap water. Shake the bottle before testing the temperature.
- Thaw and warm a bottle of frozen expressed milk by:

  ❑ holding it under running cool water and then under running warm water, and
  ❑ shake the bottle gently to mix (breast milk separates into a fatty layer and a watery layer when it is stored).

  Don't heat or shake the milk too much. Use the milk immediately after warming. If the milk has a bad odor after thawing, it may have spoiled and should be thrown out.
- Do not set breast milk out to thaw at room temperature. Do not heat breast milk on a stove.
- Always test the temperature before feeding to make sure that it is not too hot or cold (test by squirting a couple of drops onto the back of your hand).
- Thaw and/or warm only as much breast milk as you think the baby will need for a feeding.
- **Never use a microwave oven to thaw or warm breast milk—This is dangerous.** Microwave heating can result in your baby's mouth being burned from hot milk, a bottle exploding, or damage to special substances in the milk.

Relieving Common Breastfeeding Problems

Sore Nipples

To prevent or relieve sore nipples:

- Have your health care provider check for an infection that may be causing the soreness.
- Ask someone trained in lactation management for advice and to check if your baby is held, positioned on the breast, and suckling correctly during nursing. Make sure to hold your baby in the "tummy to tummy" or "chest to chest" position, and that most of the areola (the dark part of the breast) is far into his or her mouth during nursing.
- Care for your breasts by:
  - *Keeping your nipples dry between feedings*—Air dry your nipples after nursing and place dry nursing pads or similar dry breathable cloth into your bra or leave the bra flaps open (if you wear a bra). Change the pads or cloths as soon as they become wet. If you can, leave your nipples exposed to air and light (sunlight or sit under a 60-watt lightbulb) for a short while after nursing.
  - *If the nipples are washed, generally use plain, clean water*—Too much soap or shampoo on the nipple and areola removes natural oils from them. Rinse off soap or shampoo that drips onto the nipples and areola during a bath or shower. Avoid rubbing the nipples with a washcloth or other cloth.
  - *Trying to air dry your nipples with some expressed milk on them* (this may or may not help)—Do not allow the nipples to remain moist continuously to prevent sore nipples.
- Vary the positions used to nurse your baby (see figure 3, page 43, for different positions).
- Make sure to feed a young baby about every 3 hours; if fed less often:
  - the baby may be so hungry that he or she suckles very vigorously and hurts the nipples, or
  - the breasts may become so full with milk that the baby can't attach onto much of the breast, and suckles just the nipple.
- Begin each feeding with the breast that is the least sore.

Engorged Breasts

If you develop overly full, hard, or sore breasts (called engorged breasts), take these steps:

- Place warm, moist cloths or towels on your breasts or take a hot shower for about 10 minutes **before** a feeding to help the milk come out.
- Express some milk to soften the areola (the dark part of the breast) and the whole breast and allow the nipple to stick out so that baby can easily grasp it and the areola.
- Massage the breasts to "push" milk from the edges of the breast toward the nipple.
- Apply cold compresses (e.g., a washcloth chilled and rinsed under cold water) to the breast **after** feedings to reduce swelling and pain.
- Nurse frequently so that the milk does not have a chance to accumulate for longer than about 3 to 4 hours in the breasts. Thus, awaken your baby at night at least every 4 hours to nurse if he or she sleeps through the night.
- Contact your health care provider or other person trained in lactation management if this problem does not go away.

Plugged Milk Duct

If you develop a tender area on your breast or a painful lump that can be felt in the breast (these symptoms usually indicate that there is a plugged milk duct), take these steps:

- Have your health care provider check for an infection that may be causing the tenderness.
- Place warm, moist cloths on the lump and the rest of the breast or take a hot shower before a feeding.
- Massage the breast from the plugged area down to the nipple before and during nursing.
- Nurse frequently (every $1\frac{1}{2}$ to 3 hours) and vary the positions used to nurse the baby.
- Make sure your bra is not too tight; pressure on the breast can cause plugged milk ducts.
- Nurse with the baby's chin positioned toward

the plugged duct and start nursing on the affected breast first.
- Get plenty of rest.
- Contact your health care provider if this problem does not go away within 1 week.

Mastitis

If either of your breasts becomes red or tender and/or you develop flu-like symptoms (body aches, headache, nausea, fever, chills, malaise), you may have a breast infection. If you do have any of these symptoms, take these steps:

- See your health care provider immediately if you think you have a breast infection or your baby has an untreated infection.
- Continue nursing, nurse frequently, and use both breasts at each feeding. Contact your health care provider or other person trained in lactation management regarding the specific recommended treatment in your case. If your health care provider prescribes antibiotics for you, they will be the kind that do not harm your baby.
- Make sure that your baby is positioned on the breast correctly.
- Get lots of rest to clear up the infection.

Referral for Problems

- If you are concerned about any aspects of breastfeeding, ask clinic staff to refer you to someone trained in lactation management.

Tips for Nursing if Returning to Work or School

If you decide to go back to work or school or be away from your baby for some time, your baby can continue nursing successfully. If you choose to work, go to school, or leave your baby temporarily in someone else's care, try these steps (for more detail on the steps, see pages 54-56):

- Delay the return to work or school until the infant is at least 4 to 6 weeks old.
- Learn how to express breast milk by hand or by using a breast pump; try to begin expressing milk several weeks before you return to work or school (see above on expressing milk).
- The easiest time to express milk to build up a supply is in the morning. One technique that works well for many mothers is to:
  - Nurse the infant from one breast upon arising in the morning;
  - Put the infant down, and pump the milk from the other breast and store it; and
  - As soon as the pumping is finished, let the infant nurse on the side that was just pumped. Babies usually drink the remaining milk left after the pumping. The extra suckling will increase the amount of milk you make.
- Nurse the baby when home; express milk during the day if possible. Some mothers go to their baby or have him or her brought to them for nursing at lunch time. If you can not express milk, infant formula prescribed by your health care provider can be provided to your baby when you are away.
- Ask about breastfeeding support (like a special room for nursing, or a refrigerator for storing milk) at the workplace or school.
- Make arrangements for safely storing expressed breast milk while away from home. It helps if a refrigerator is available for storage at work or school. If not, some mothers store their milk in a cooler packed with ice or an ice gel pack (see above for information on storage of breast milk).
- When making arrangements for child care for your baby (e.g., a babysitter or a day care center), try to choose a babysitter or day care center which is supportive of breastfeeding and, in the case of the center, allows you to nurse if you visit. Instruct the babysitter or center on:
  - How to use frozen breast milk (see above for instructions); and
  - How much expressed breast milk (or infant formula) the baby usually eats and how often he or she usually eats. The person taking care of the baby should still be encouraged to follow the baby's lead in deciding when and how much to feed.
- Introduce your baby to drinking from a bottle and to being fed by someone else besides you—some recommend introducing a bottle 2 weeks before returning to work or school and preferably no sooner than when the baby is 3 to 4 weeks old.

- Nurse regularly on weekends and evenings. As the week progresses, some nursing mothers may find that there seems to be less milk to express—this is normal. You will make enough milk if you:
  - Nurse (or pump) often (six or more times a day during the week and more on weekends);
  - Get adequate rest; and
  - Eat a well-balanced nutritious diet.

Weaning

- If weaning a breastfed baby, try to do so gradually.
- You can wean your baby by replacing feedings from the breast with feedings of infant formula (or whole cow's milk if the baby is over 1 year old). The first nursing to replace is the one which the baby is least interested in or when the breasts do not feel full. Gradually, other nursings can be dropped and you can go from nursing once per day to every other day.
- If your baby is over 6 months old and you wish to wean from the breast, the baby can be weaned to a cup and/or bottle. It may be easier to use powdered formula since it allows for single feedings to be prepared easily without wasting formula.
- Even though mostly weaned, a baby can still be nursed just for comfort or to relax.

Formula Feeding and Use of Bottles

When and How Much to Feed Baby

- Feed your baby when he or she shows signs of hunger (the baby may wake and toss, suck on a fist, cry or fuss, or look like he or she is going to cry to show hunger). Respond to the early signs of hunger; do not wait until the baby is upset or crying from hunger. Avoid putting your baby on a rigid feeding schedule unless recommended for medical reasons.
- Newborn babies may initially feed 8 to 12 times per day (every $1\frac{1}{2}$ to 3 hours) and may drink from 2 to 3 ounces at a feeding. As your baby gets older, he or she will gradually drink more formula at each feeding, not drink as many times per day, and drink a larger total amount of formula in a day.
- Between 6 and 12 months old, most babies begin eating more solid foods, drink fewer formula bottles, and less total formula per day than before 6 months.
- If your baby is over 6 months old and on a variety of solid foods, he or she should not need more than about 32 ounces of formula in 24 hours. If your baby is still hungry after finishing that amount, he or she may need more solid foods instead of more formula. (See figure 9, pages 108-109, for guidelines on ranges of formula in the first year.)
- If you feed your baby both infant formula and breast milk, the amount of formula to feed will vary depending on how often the baby nurses.

Preparing for Feeding

- Hold, rock, or play with your baby when fussy or crying before concluding that it is time for a feeding. It is important to show love, comfort, and cuddling and talk to your baby during feedings but also between feedings.
- Gently and slowly calm your baby to get ready for feeding.

How to Feed With a Bottle

- Wash your hands with soap and hot water before feeding.
- Feed in a smooth and continuous fashion following your baby's lead on when to feed, how long to feed, and how much to feed. Try not to disrupt the feeding very often to burp, juggle, or arrange the baby.
- Hold your baby during bottle feedings. Tip the bottle so that milk fills the nipple and air does not get in. Hold your baby's head a little higher than the rest of the body to prevent milk from backing up in the inner ear and causing an ear infection. Older babies can hold the bottle while feeding but they should be sitting in your arms or in a highchair or similar chair and the bottle should be taken away when the feeding is finished.
- Make sure the nipple hole is large enough so that if you hold the bottle upside down, falling drops follow each other closely but do not make a stream. Also, adjust the nipple ring so that some air can get into the bottle to avoid a collapsing nipple.

- Do not prop the bottle—this can cause ear infections and choking, and it deprives the baby of important cuddling and human contact.

Burping

- Wait for your baby to pause or stop eating before burping. Burp by gently patting or rubbing baby's back while he or she is held against the front of your shoulder and chest or held in a sitting position in your lap. Do not be surprised if your baby brings up some milk along with the swallowed air or if he or she does not burp.

Don't Feed a Bottle While Napping or Sleeping

- Do not offer the bottle at nap or sleeptime. Allowing a baby to go to sleep with a bottle may lead to choking or baby bottle tooth decay.

Signs of Fullness

- Continue to feed until your baby indicates fullness. Signs of fullness include: sealing the lips, a decrease in sucking, spitting out the nipple, and turning away from the bottle.
- Do not force your baby to finish what is in the bottle. Babies are the best judge of how much they need.

Drinking From a Cup

- Infant formula can be offered from a cup as your baby gets older. Babies will consume less formula from the bottle as their intake of solids and drinking from a cup increases.
- Try to wean your baby off the bottle and onto a cup by about 1 year old.

Purchasing, Preparing, and Storing Formula

Formula Selection

- In selecting cans of formula, check the formula's expiration date on the label or the lid. If the date has passed, do not select the formula can.
- Do not select cans of infant formula that have dents, puffed edges or bulges, pinched tops or bottoms, leaks, or rust spots.

Formula Preparation

- Prepare concentrated, ready-to-feed, or powdered infant formulas properly according to directions on the container or to instructions given to you by clinic staff. (Instructions for preparation of standard milk- and soy-based infant formulas are also provided in figures 7a, b, and c, pages 80-82.) See below, page 143, on avoiding overdiluting your baby's formula with too much water.
- Before opening a can of formula, wash the can lid with soap and water to remove dirt that could contaminate the formula.

Sterilization of Water and Bottles

- If your baby is less than 3 months old, first clean bottles well using soap, hot water, and bottle and nipple brushes, and then either sterilize bottles and their parts (nipples, caps, rings) in boiling water for 5 minutes or wash them in a properly working dishwasher machine.
- If disposable plastic bottle liners are used, discard the bags after one use, and either sterilize the nipples, rings, and caps in boiling water or wash them in a dishwasher until the infant is at least 3 months old.
- After 3 months old, unless otherwise indicated by a health care provider, bottles and bottle parts can be washed using soap and hot water, and bottle and nipple brushes, or in a dishwasher.
- Preboil water for baby's formula until baby is 3 months old. Ask your health care provider about whether to boil the water used to prepare formula after baby is 3 months old. If you are in doubt about the safety of the water supply or if there are reports in the community about the water supply being contaminated, it would be wise to boil the water before using it or find an altemative source of clean water (see pages 21-22). Water can be preboiled by bringing the water to a rolling boil, boiling it for 5 minutes, and then letting it cool. Avoid boiling for a long time.

Safety of the Water Supply

- If you're pregnant or have a baby or child, it is a good idea to have your water tested for contaminants (such as lead, nitrates, and bacteria) which may be in some water supplies. If you use well water or water from a questionable source, it is important to have the water tested to check its quality. For more information on water safety and water testing, you can contact:

  - Your local health department;
  - Your State drinking water office; or
  - The Environmental Protection Agency's (EPA) Safe Drinking Water Hotline at 1-800-426-4791, from 9:00 a.m. to 5:30 p.m., Monday through Friday, eastern time.

  If your water is contaminated, talk to your health care provider about how to get a safe water supply for your baby. See box on pages 20-23 for more information on the safety of water (including on lead, nitrates, and copper in water, well water, bottled water, and home water treatment units).

Lead in Water

- Lead can enter drinking water from plumbing pipes and materials within homes and residential buildings. Lead is very dangerous to babies, children, and pregnant women. To reduce the possible leaching of lead from metal water pipes in your home, take these steps when using tap water to prepare powdered or concentrated infant formula or foods for an infant:

  - Run the cold tap water for a short period of time until it is as cold as it will get (about 2 minutes) before collecting for formula or food preparation. Do this for any faucet used to collect water for your baby. This process flushes out lead that may be in the water (however, this flushing might not work in high-rise buildings or if pipes outside your home contain lead). Water for making formula can be collected in the evening after the water has been running for cooking or cleaning and stored in a clean container for use later.
  - Always draw water for formula preparation, drinking, and cooking from the cold water tap. Avoid feeding water from the hot water tap to your baby or any young child (hot water is more likely to dissolve lead from plumbing materials).
  - If boiling water for your baby, do so by bringing the water to a rolling boil and boiling for only 5 minutes. Avoid boiling for a long time or reboiling which can increase the amount of lead in the water.
  - Water treatment devices installed at the tap may not reduce lead in the water, depending on the type and location of the device and whether you follow the manufacturer's maintenance and other instructions. Some, like reverse osmosis and distillation units, may be effective. Carbon, sand, and cartridge filters do not remove lead.
  - Have your water tested for lead.

  If you are concerned about the lead level in water or if lead contamination is found through testing, discuss this with your health care provider. The health care provider might recommend using distilled bottled water to mix with infant formula powder or concentrate, or recommend ready-to-feed infant formula which does not require mixing with water.

Storage of Infant Formula

- When preparing formula to be stored, pour the formula into bottles in single feeding portions (e.g., pour 26 ounces of standard dilution formula into five bottles each containing 4 to 6 ounces).
- After preparation, store bottles of formula in a properly working refrigerator until ready to use and use them within 48 hours from the time they were prepared. Opened cans of formula should be covered, refrigerated, and used within 48 hours. (Use a special thermometer to test if your refrigerator is 40° F or below.) Do not freeze infant formula.
- Do not leave prepared bottles of formula out at room temperature longer than 2 hours.
- Throw out any formula left in a bottle after a feeding. The mixture of formula with baby's saliva promotes the growth of disease-causing germs.

- Clean used bottles and their parts using soap, hot water, and bottle and nipple brushes, and if your baby is less than 3 months old, sterilize those items by boiling them in water for 5 minutes or clean them in a dishwasher, as shown in figures 7a, b, and c, pages 80-82, before reusing to feed your baby.

Warming Infant Formula

- If your baby prefers a warmed bottle, warm the bottle of formula immediately before serving by holding it under running warm water.
- Warm only as much formula as you think your baby will need for a feeding.
- Test the temperature of the liquid in the bottle before feeding to make sure it is not too hot or cold. Shake the bottle well before testing the temperature. Test the temperature by squirting a couple of drops of the liquid onto the back of your hand.
- **Never use a microwave oven to warm bottles—This is dangerous**. Microwave heating can result in your baby's mouth being burned from hot formula or a bottle exploding. Pockets of hot liquid could develop causing the bottle to feel warm while a portion of the liquid is very hot.

Traveling with Infant Formula

- When traveling with a formula-fed infant, take along a can of powdered formula and separate water in a clean bottle (or sterilized bottle if your baby is less than 3 months old). Then, the formula can be mixed up to make single bottles when needed. Nursettes or single cans of ready-to-feed formula could be used instead.
- Do not travel with bottles of unrefrigerated infant formula kept at room temperature.

When Leaving Baby With a Temporary Caregiver

- If you leave your baby in the care of a babysitter or family member, give that person specific instructions for warming, feeding, and handling bottles. Don't assume the person knows about using bottles and your appliances.

Introducing Semisolid Foods

Signs of Developmental Readiness

- Introduce semisolid foods when your baby is developmentally ready, which means that the baby can:
  - Hold his or her head up and sit in a chair with support;
  - Keep food in his or her mouth and swallow it; and
  - Draw in his or her lower lip as a spoon is removed from the mouth.

Appropriate Age for Solid Foods

- Most babies start on solid foods between 4 and 6 months old. By 6 months old, most babies should be eating some solid foods. Do not delay the introduction of solid foods beyond 8 months old.

How to Introduce Foods

- Make mealtimes enjoyable and relaxing for your baby.
- Wash your baby's hands and face frequently and especially before he or she eats. A baby's hands can pick up germs, lead paint chips, etc. which could be harmful.
- When offering your baby solid foods, sit directly in front of your baby and offer the spoon straight ahead. Wait for the baby's mouth to open before putting the spoon to the baby's lips. Use a small spoon and place a small amount of food between the baby's lips. At first, your baby may force much of the food out of his or her mouth, but gradually he or she will learn to move the food to the back of the mouth for swallowing. Over time, your baby will increase the amount of food eaten.
- Feed solid foods using a spoon. Generally, do not feed cereal or other solid foods in a bottle or an "infant feeder." Babies who are not ready to eat from a spoon are not ready to eat solid foods. Putting solid foods in a bottle is a form of force-feeding and is not recommended.
- Babies touch and play in their food and should be expected to be messy. Be patient and do not scold your baby for spilling foods

or beverages. Fabric or newspapers can be placed under the high chair to make cleaning up easier.
- Use a small baby spoon and a small unbreakable bowl with smooth edges to feed your baby.
- While eating, your baby should be sitting comfortably in a sturdy highchair (or similar chair) which can safely secure him or her and prevent falls. Do not feed your baby while he or she is crawling or walking—eating while moving could cause choking.

How Much and How Often to Feed

- Let your baby be your guide as to how much food to feed. You may start with 1 to 2 teaspoons of each food once a day and gradually find that your baby will eat 2 to 4 tablespoons of each food at meals. A 4- to 6-month-old baby may start out with one meal per day which includes solid foods, then gradually work up to about 3 meals and 2 to 3 snacks per day, at 8 months old.
- Do not force your baby to finish a serving of food. Feed until your baby indicates fullness by:

  - Pulling away from the spoon;
  - Turning his or her head away;
  - Playing with the food;
  - Sealing his or her lips;
  - Pushing the food out of his or her mouth; or
  - Throwing the food on the floor.

- Babies are the best judge of how much food they need, so allow your baby to determine how much he or she eats. Try to follow your baby's lead on how often and fast to feed, food preferences, and amount of food. Be patient and allow your baby time to adapt to the new textures and flavors of solid foods.

Watching for Reactions to Food

- Introduce new foods gradually. Only introduce one new food at a time. Wait no less than about 1 week between introducing new foods so that you can watch for any reactions to the food. Observe your baby closely for reactions after feeding a new food.
- Introduce a small amount (e.g., about 1 to 2 teaspoons) of a new food at first (this allows the baby to adapt to a food's flavor and texture).
- Use single-ingredient foods at first so you can see how baby accepts them (e.g., try plain rice cereal before rice cereal mixed with fruit).
- Symptoms of a reaction to food may include diarrhea, vomiting, coughing and wheezing, respiratory symptoms, ear infections, shock, abdominal pain, hives, skin rashes (like eczema), and extreme irritability. Stop feeding those foods that your baby has a reaction to and ask your health care provider about the reaction. If your baby seems to be having a severe reaction to food (e.g., difficulty breathing, shock), contact a health care provider and/or the rescue squad immediately.
- If your baby does not like the taste of a new food at first, you can try offering it again 3 or 4 weeks later. Each time you offer the new food, your baby may become more used to it.

Introducing Water When On Solid Foods

- Offer small amounts of water during the day (total of about 4 to 8 ounces) if your baby has started eating a variety of solid foods, especially protein-rich solid foods. (Also see pages 129 and 143.)

Vitamin/Mineral Supplements

- Do not give your baby vitamin drops unless your health care provider recommends them.
- Keep all vitamin/mineral pills or drops, and any other pills, medicines, poisons, etc., locked in a secure place, out of your baby's or child's sight and reach.

Reducing Lead Exposure from Food

- Do not feed your baby canned imported foods or beverages— these cans may have lead seams (lead in seams can enter the food).
- In preparing, storing, or serving foods for your baby:

  - Avoid using ceramic ware or pottery, especially if imported from another country, for cooking, storing, or serving food or beverages.

- Do not use leaded crystal bowls, pitchers, or other containers to store foods or beverages.
- Never cook or store foods in antique or decorative ceramic or pewter vessels or dishes.
- Do not use antique utensils for preparing or serving baby's foods.
- Store foods or beverages in plastic or regular glass containers.

When Leaving Baby With a Temporary Caregiver

- If you leave your baby in the care of a babysitter or family member, give that person specific instructions for warming, feeding, and handling the baby's food. Don't assume the person knows about baby foods and your appliances.

Making Homemade Baby Food

Cleanliness

Cleanliness is important when making baby foods at home. Take these steps to keep baby's food clean:

- Wash hands with soap and hot water and rinse well:
  - Before nursing, bottle feeding, or preparing any food or bottles;
  - **Before** handling any food or food utensils and **after** handling raw meat, poultry, or fish;
  - After changing baby's diaper and clothing; and
  - After using the bathroom.
- Take extra care when handling an infant's food, bottles, and utensils.
- Before preparing food, wash all working surfaces used to prepare food, such as countertops or tables, with soap and hot water and then rinse well with hot water.
- Before preparing food, wash all equipment, such as a blender, food mill, food processor, baby food grinder, utensils, pots, pans, and cutting boards carefully with soap and hot water. Rinse thoroughly with hot water, and allow to air dry. Separate cutting boards should be used for animal foods (i.e., meat, poultry, fish) and nonanimal foods (i.e., vegetables, fruits, breads).

Type of Food to Use

- Start with good quality fresh foods, if possible, in making baby foods. Plain frozen foods, with no added sugar, salt, or sauces, are also a good choice. If canned foods are used, select those without salt or syrup, or packed in their own juice (if regular canned foods are used, pour off syrup or salty water and rinse the food with clean water).

Equipment

- Common kitchen equipment is all that is needed to make baby foods at home. The texture of foods can be changed to meet your baby's needs using a blender, food mill, food grinder, strainer, or by mashing with a fork.

Food Preparation

In preparing the food:

- Wash, peel, and remove the seeds or pits from vegetables and fruits. Cook vegetables and hard fruits, like apples, until tender. Edible skins and peels can be removed either before or after cooking.
- Remove bones, fat, and gristle from meats, poultry, and fish. Meats, poultry, fish, dried beans or peas, and egg yolks (not egg whites) should be well cooked. Baking, boiling, broiling, poaching, steaming are good cooking methods (see page 95 for guidelines on cooking of meats, poultry, and fish).
- Blend, grind, or mash the food to a texture and consistency that is appropriate for your baby's stage of development. Food texture should progress from being pureed to mashed to diced. Providing new textures encourages the baby's further development.
- If using the same foods that the family eats, the baby's portion can be separated before adding salt, sugar, syrup, gravy, sauces etc. Baby food may taste bland to you, but it is fine for your baby.

Serving Food

- Serve freshly cooked food to your baby shortly after preparing it. Allow the food to cool for a short time so that it does not burn your baby's mouth. Before feeding, test the temperature of foods using a different spoon than the one used to feed your baby.

- Foods should not be chewed by someone else before feeding them to the baby. Saliva from another person can add harmful bacteria to a baby's food.

Storage of Food

- If freshly cooked food is not served to the baby, immediately refrigerate or freeze it. (Use a special thermometer to test if your refrigerator is 40° F or below and your freezer is 0° F or below.) Do not allow cooked foods to stand at room temperature; harmful germs can grow in the food at this temperature.
- Throw out foods that are left unrefrigerated for 2 hours. Remember the concept "If in doubt, throw it out." That is, if you think that you may have left your baby's food unrefrigerated for over 2 hours, throw it out. Do not taste the food to see if it is safe because a food can contain harmful germs yet taste and smell normal.
- Two easy methods of storing baby food in serving-size amounts (after it has cooled) in the freezer include:

  - **Ice cube tray method**—Pour cooked pureed food into sections of a clean ice cube tray; cover with plastic wrap, a lid, or aluminum foil; and place into the freezer.

  - **Cookie sheet method**—Place 1 to 2 tablespoons of cooked pureed food in separate spots on a clean cookie sheet, cover with plastic wrap, or aluminum foil, and place into the freezer.

  When frozen solid, the frozen food cubes or pieces can be stored in a freezer container or plastic freezer bags in the freezer. Label and date the bags or containers of frozen food and use them within 1 month. When ready to use, the desired number of cubes or pieces can be removed from the bag or container and reheated. Do not thaw frozen baby food at room temperature.

Using Stored Food

- Use freshly prepared refrigerated food within 48 hours (except meats and egg yolks which should be used within 24 hours). Use frozen foods within 1 month.
- Thaw food in refrigerator or under cold running water. Thoroughly reheat refrigerated or frozen home-prepared baby foods before feeding them to your baby. Reheating kills harmful germs which can grow slowly while a food is in the refrigerator or during thawing. Test the temperature of the food before feeding it to your baby. Throw out any leftover food that your baby does not eat.
- Do not refreeze baby food which has been removed from the freezer and allowed to thaw. Store thawed food in the refrigerator and use it within 48 hours (24 hours for meats) or throw it out.

Purchasing, Serving, and Storing Commercial Baby Food

Single-ingredient Foods Provide More Nutrition for Your Money

- Single-ingredient foods (like plain fruits, vegetables, and meats) provide more nutrition for your money than combination foods or mixed dinners.
- Older babies who are ready for foods with a chunkier texture can be shifted to mashed or finely chopped home-prepared foods instead of baby food combination dinners; this helps the baby to learn new eating skills.

Read Food Labels

- Read the ingredient list on the food label. Ingredients are listed on the label in order of those present in the largest amount to the smallest amount. Labels help you to tell, for example, which foods contain more water than others, and which contain added sugar and salt.

Selecting Commercial Baby Foods

- Select jars that are clean, have no cracks, have no rust on the lid, and are not sticky or stained. Sticky jars may be cracked or have glass on them from cracked jars they were packed with.
- Observe "use-by" dates for purchase and pantry storage of unopened jars. If the date has passed, do not use the food.

Opening Jars

- Wash the jar with soap and hot water before opening it.
- Make sure the vacuum seal on a jar of baby food has not been broken before using the food. Baby food jars have a button, or depressed area in the center of the lid, which is an indicator of whether the vacuum seal has been broken. Do not select or use any jar of baby food with the button popped out. You should hear a popping or "whoosh" noise when the seal is broken. To make it easier to open the jar, run it under warm water for a few minutes. Do not tap the jar lid with a utensil or bang it against a hard surface; this could break glass chips into the food. If a grating sound is heard when opening the jar lid, check to see if there are any glass particles under the lid.

Heating the Food

- If you need to heat the food, a safe way to do so is by removing it from a jar, heating it in a pan on the stove, stirring it, and testing its temperature before feeding.
- Never heat jars of baby food in a microwave oven. Even though some baby food jars indicate that they can be heated in a microwave, this could be dangerous. A microwave oven may heat the food unevenly so that some of the food is hot enough to burn the baby's mouth.

Serving the Food

- Serve your baby's food in a bowl. Do not use the baby food jar as a serving dish. Most babies cannot finish a small jar of baby food at one feeding. Also, if a spoon used for feeding is stuck into the jar, the baby's saliva could contaminate and spoil the rest of the food. Thus, remove the desired amount of food from the jar using a clean spoon and put it into a bowl for serving. Always examine the food for abnormal particles when transferring it from the jar to the bowl.
- Throw away any leftover food in the bowl. Do not put leftover food back into the jar because it could add germs to the food in the jar.

Storing the Food

- Once a jar is opened, store it in the refrigerator and use the food within 48 hours, except for baby food meats and egg yolks which should be used within 24 hours. If not used within these time periods, throw out the food.

Use of Specific Types of Foods

(See Chapter 5 for more detailed information on the purchase, preparation, serving, and storage of the below foods)

Infant Cereal

- Infant cereal can be introduced between ages 4 and 6 months. Feed cereal to the baby using a spoon, not a bottle.
- Start with rice cereal as the first cereal introduced, followed by oat and barley cereals. Wait no less than about 1 week between trying each new cereal.
- Wait to introduce wheat cereal until your baby is 8 months old, when the baby is less likely to have an allergic reaction to wheat.
- Mixed grain cereals and cereal-and-fruit combinations may be tried after your baby has been introduced to each food in the mixture.
- Feed your baby cereal that is designed for babies. Avoid feeding your baby ready-to-eat cereals designed for adults and older children (these cereals do not contain the right amounts of vitamins and minerals for a baby and may cause choking).
- Mix dry-pack infant rice cereal with expressed breast milk, infant formula, water, or fruit juice (if baby has already tried it and had no reactions to it) to produce a smooth mixture. The consistency of all cereals can be thickened by adding less liquid as your baby matures. Measure the desired amount of dry cereal before adding the liquid.

Fruit Juice

- Only introduce fruit juice when your baby is able to drink it from a cup with help. Do not feed fruit juice in a bottle because this practice increases the risk of developing baby bottle tooth decay.
- Offer your baby only 100 percent fruit juice. Avoid feeding your baby any fruit-flavored

drinks, punches or aides, soda pop, gelatin water, or other beverages which are high in sugar and contain few nutrients. Read food labels carefully.

- Introduce single varieties of fruit juice first. If your baby has no reactions, then mixed juices, containing the single varieties of juice already tried, can be introduced.
- When using juice from commercial infant juice bottles, pour 2 to 4 ounces of juice out of the bottle container into a cup.
- Limit the total amount of juice fed to a baby to about 4 ounces per day because too much juice can spoil the baby's appetite for other nutritious foods.
- Watch for any reactions in your baby when introducing citrus (orange, tangerine, or grapefruit) pineapple, or tomato juices and delay introducing them until the sixth month or older—these juices may cause allergic reactions in some babies.
- If canned juices are used, pour the juice into a glass or plastic container for storage after the can is opened. Once the can is opened and air enters the can, the can begins to corrode which can affect the juice's flavor.
- Avoid feeding your baby imported canned juices because the seams of these cans may contain lead.
- Do not self-treat diarrhea or illness in your baby with fruit juices or sweetened beverages—rather, contact your health care provider if your baby has diarrhea or illness.

Vegetables and Fruits

- Vegetables and fruits can be introduced between 6 and 8 months old. Almost any soft-cooked fruit or vegetable can be fed as long as it is prepared in a consistency that the baby can safely eat. As your baby gets older, the thickness and lumpiness of vegetables and fruits can gradually be increased.
- Remember to wait no less than about 1 week between introducing each vegetable or fruit and observe your baby carefully for reactions to the food.
- These vegetables, for example, can be prepared as baby foods: asparagus, broccoli, brussels sprouts, cabbage, carrots, cauliflower, collard greens, green beans, green peas, green peppers, kohlrabi, kale, plantain, potatoes, spinach, summer or winter squash, and sweet potatoes. Fresh vegetables generally need to be cooked until just tender enough to be pureed or mashed.
- *Do not feed home-prepared spinach, beets, turnips, carrots, or collard greens to your baby if under 6 months old.* These vegetables all tend to be high in nitrates (from the soil) which could harm very young babies.
- These fruits, for example, can be mashed (after peeling) without cooking if ripe and soft: apricots, avocado, bananas, cantaloupe, mango, melon, nectarines, papaya, peaches, pears, and plums. Stewed pitted dried fruits can be pureed or mashed. Apples, pears, and dried fruits usually need to be cooked in order to be pureed or mashed easily. Older babies can be given small pieces of ripe, soft fruit such as ripe peeled peach, nectarine, or banana.
- Avoid feeding these vegetables and fruits to your baby due to the risk of choking: raw vegetables (including green peas, string beans, celery, carrot, etc.), cooked or raw whole corn kernels, whole grapes, berries or cherries, uncooked dried fruit (including raisins), fruit pieces with pits, whole pieces of canned fruit, and hard pieces of raw fruit.
- If commercially prepared baby food is used, plain vegetables and fruit provide more nutrition for your money than fruit desserts and mixtures.
- If vegetables and fruits are prepared at home, try to select high quality fresh or plain frozen produce to prepare baby's food. If canned foods are used, select those without salt or syrup, or packed in their own juice (if regular canned foods are used, pour off syrup or salty water and rinse the food with clean water).
- Store opened jars of baby food vegetables or fruit for no longer than 48 hours in the refrigerator.

Protein-Rich Foods

- Babies can be introduced to these foods between 6 and 8 months old: cooked strained or pureed lean meat, chicken, or fish, cooked egg yolk, cooked dried beans or peas, tofu, mild cheese, cottage cheese, or yogurt.
- If using commercial baby food meats, single-ingredient jars of meat (like beef, lamb, chicken) contain more nutrients for your money than mixed meat dinners (like chicken noodle,

vegetable beef, or turkey rice dinner).

- After purchasing meats, poultry, fish, or eggs, get them home quickly and store in the refrigerator or freezer. Keep juices from raw meat, poultry, and fish away from other foods (the juices that drip may have germs).
- If home-cooked meats are prepared, it is best to bake, broil, poach, stew, or boil the meat, poultry, or fish. After cooking, puree or finely chop the food. There is no need to add gravies or sauces to meats prepared for your baby.
- Cook meat, poultry, and fish until they are done:

  - Cooked red meat looks brown inside (not red or pink);
  - Poke cooked chicken with a fork. The juices should look clear, not pink; and
  - Dig a fork into cooked fish. The fish should flake.

- Store freshly cooked or opened jars of plain strained meats and egg yolks for no longer than 24 hours in a refrigerator.
- *Avoid feeding your baby these foods:*

  - Egg white, whole egg (because of the egg white), or shellfish before 1 year old—babies are often allergic to these foods;
  - Hot dogs, sausage, luncheon meats, bacon, or other cured meats—these meat products contain high levels of salt and fat; and
  - The fat and skin trimmed from meats.

- Never feed your baby any raw or partially cooked eggs, meat, poultry, or fish or food products that contain them—these foods may contain harmful germs that could make your baby very sick.
- Watch closely for any reactions in your baby when introducing any fish—fish may cause allergic reactions in some babies. Contact your State department of health or natural resources about the safety of local fresh water sport fish before feeding them to your baby. Avoid feeding your baby these fish: east coast salmon, swordfish, shark, catfish, clams, and lake whitefish. Check for and carefully remove bones before cooking fish.
- Do not use eggs that are broken in the egg carton. Wash the outside of eggs before breaking them.
- Only feed the yolk of an egg to your baby. To prepare, boil a whole egg until the egg yolk is firm, not runny. Separate the cooked egg yolk and mash it with water or infant formula. Do not feed egg whites to your baby until 1 year or older.
- Cottage cheese, hard cheeses, and yogurt can be gradually introduced as occasional foods. Cheese can be eaten cooked in foods or as slices (do not feed chunks of cheese which could cause choking). Observe your baby closely for reactions after he or she eats these foods.
- Cooked legumes (dry beans and peas) or tofu (bean curd made from soybeans) can be introduced into a baby's diet as a protein food. It is best to introduce small quantities (1 to 2 teaspoons) of mashed or pureed legumes at first (whole beans or peas could cause choking). Observe to see if your baby does not like them, has a reaction to the food, or appears to have difficulty digesting them. If so, they can be introduced again later.
- Home-prepared dry beans or peas are more economical and lower in salt than canned beans. But, if canned beans are used, drain the salty water and rinse the beans with clean water before using. Instructions for cooking dry beans and peas can be found on the package label and in many basic cookbooks.
- Tofu (bean curd) can also be mashed and fed to babies. Select fresh tofu; i.e., tofu prepared daily if made fresh, or water-packed tofu which has not expired. After purchasing, tofu should be:

  - Stored immersed in fresh cold clean water; the water should be changed right after purchasing and daily;
  - Always stored in a refrigerator; and
  - Cooked for a short time (e.g., boil in clean water for about 5 minutes, then allow to cool) before feeding to an infant.

- When your baby starts on any of the above protein-rich foods, give him or her some water (about 4 to 8 ounces) to drink each day.

Grain Products

- At 8 months and older, babies can try plain crackers, teething biscuits, whole-grain or enriched bread, plain cooked noodles, macaroni, ground or mashed rice, corn grits, soft tortillas, zwieback, and graham crackers. A baby's risk of having a reaction to wheat decreases at this age. These foods can be introduced as snacks, finger foods, or as additional foods at meals.
- Avoid feeding your baby highly seasoned snack crackers or those with seeds, snack potato or corn chips, pretzels, cheese twists, breads with nut pieces, or whole grain kernels like wheat berries or whole kernels of cooked rice, barley, wheat, or other grain—babies can choke on these foods.

Finger Foods

- At about 8 months old, babies begin to feed themselves with their hands and can start to eat some foods which they can pick up and eat easily without choking.
- Good finger foods include soft cooked macaroni or noodles, small pieces of soft bread, small pieces of soft, ripe peeled fruits (like banana) or soft cooked vegetables, small slices of mild cheese, crackers, or teething biscuits. Make sure that the baby eats biscuits, toast, or crackers (and other foods) in an upright position to reduce the chances of choking on crumbs.

Sweetened Foods and Sweeteners

- Plain fruit (home-prepared or commercial) is a nutritious dessert for your baby.
- Avoid feeding your baby these foods and items:
  - Chocolate, before 1 year old—some babies are allergic to this food;
  - Commercially prepared baby food desserts or commercial cakes, cookies, candies, and sweet pastries—these foods tend to be high in sugar;
  - Sugar, maple syrup, molasses, corn syrup, glucose, or other syrups added to the baby's food or beverages, or put onto a pacifier; and
  - Foods, beverages, or powders containing artificial sweeteners. Babies do not need low-calorie foods or drinks in their diets.
- **Never feed honey—plain, in cooking or baking, or as part of processed foods—to your baby.** Honey sometimes contains dangerous spores which can cause a serious illness in a baby, called infant botulism. Adults and children over 1 year old can destroy the spores that may be in honey.

Beverages Other Than Breast Milk, Infant Formula, and Fruit Juice

- *Feed your baby some water (total of about 4 to 8 ounces) each day if:*
  - Your baby starts eating a variety of solid foods, especially protein-rich solid foods;
  - The weather is hot and your baby is either formula-fed (any age) or breastfed (and is eating a variety of solid foods); and/or
  - Your health care provider recommends doing so because of illness or health reasons.
- *Do not feed your baby large amounts of water. Remember these points to make sure your baby does not take in too much water:*
  - Do not dilute your baby's formula with extra water in order to "stretch" it. Make and dilute formula correctly (see pages 77-79 and figures 7a, b, and c, pages 80-82);
  - If you have run out of the infant formula you get from WIC or CSFP and need more formula to feed your baby:
    - ❑ Ask the WIC or CSF Program staff about providing you with powdered infant formula which makes more formula per day than the concentrated or ready-to-feed infant formula; and
    - ❑ Contact WIC or CSF Program staff or a social worker for help in getting extra formula for your baby.
  - Do not feed your baby plain water or dilute liquids (e.g., fruit juice, sweetened beverages, tea) in place of breast milk or infant formula. Water and fruit juice are meant to be fed in small amounts (about 4 to 8 ounces per day for water and 2 to 4 ounces per day for fruit juice).
  - Do not let your baby suck on or feed from a bottle of water or dilute liquids (e.g., fruit

juice, sweetened beverages, tea) all day or for long periods. Young babies need to be fed enough breast milk, infant formula, and/or appropriate solid foods to meet nutrition needs.
- See a health care provider immediately if your baby has diarrhea or other illness and do not self-treat your baby at home.
- Do not routinely feed water to your baby right after nursings or formula feedings.
- A baby who drinks too much water and not enough breast milk or infant formula, or food, can get very sick.

- *Avoid feeding your baby any of these beverages:*

  - Coffee, regular or herbal teas, or hot chocolate—these beverages contain substances which may harm your baby;
  - Whole cow's milk, goat's milk, soy drinks or beverages, imitation milks, coffee whiteners—these do not have the right balance of nutrients needed by your baby; and
  - Sweetened beverages (see below under Oral Health).

- **Never feed your baby any alcoholic beverages.**

Choking Prevention

Babies can choke easily. To decrease your baby's risk of choking:

- Serve foods that are the appropriate texture for your baby's development. Prepare food so that it is soft and does not require much chewing.
- Cook foods until soft enough to easily pierce with a fork.
- Puree, blend, grind, or mash and moisten food for young babies.
- For the older baby close to 1 year old, who can chew, cut foods into small pieces or thin slices that can easily be chewed.
- Cut round foods, like cooked carrots, into short strips rather than round pieces. Do not feed raw whole grapes, cherries, or berries to your baby; these fruits should be cut into quarters, with pits removed, before feeding. Large pieces of food can become lodged in the throat and cause choking.
- Remove all bones from poultry and meat and especially from fish, before cooking. Remove hard pits and seeds from vegetables and fruit.
- Substitute foods that may cause choking with a safe substitute, such as meat chopped up or mashed hamburger instead of hot dogs or pieces of tough meat.
- Do not feed whole grain kernels of wheat, barley, rice, etc. to your baby. These grains must be cooked and finely ground or mashed before being fed to a baby.
- Do not feed whole nuts or seeds or nut/seed butters to babies. Whole nuts and seeds can lodge in the throat or get caught in the windpipe and nut/seed butters can get stuck to the roof of the mouth.
- Supervise your baby's mealtimes and snacks and do not leave baby alone when eating. Make sure your baby is sitting still and in an upright position during meals. Encourage your baby to eat slowly.
- Feed small portions.
- Hold your baby while feeding a bottle. Never "prop" a bottle for your baby at any age. Do not leave a bottle in baby's crib or playpen. (Older babies can hold the bottle while feeding but they should be sitting in your arms or in a highchair or similar chair and the bottle should be taken away when the feeding is finished).
- Make sure the hole in the nipple of your baby's bottle is not too large, to avoid the liquid from flowing through too rapidly.
- Make sure that biscuits, toast, and crackers are eaten only when baby is in an upright position. A baby who eats these foods while lying down could choke on crumbs.
- Avoid using teething pain relief medicine before mealtime since it may interfere with chewing.
- *In summary, do not feed babies any:*

  - tough meat
  - peanuts or other nuts and seeds
  - hard candy
  - marshmallows
  - popcorn
  - whole grapes, berries, or cherries
  - uncooked raisins and other dried fruit
  - chewing gum
  - peanut and other nut/seed butters
  - hot dogs or sausages

- whole beans
- hard pieces of raw fruit
- potato/corn chips
- large chunks of cheese
- cooked or raw whole-kernel corn
- plain wheat germ
- fish with bones
- cookies
- whole grain kernels
- raw vegetable pieces (e.g., carrots, green beans, string beans, celery, etc.) or hard pieces of partially cooked vegetables
- whole pieces of canned fruit (cut them up instead)
- fruit pieces with pits

See above for some finger foods that are acceptable for babies.

Oral Health

General Prevention of Tooth Decay

To prevent tooth decay:

- Bottles should be used for feeding infant formula, expressed breast milk, or a small amount of water (see guidelines above on feeding water).
- Feed fruit juice only in a cup. Drinking from a cup will be messy at first. Be patient and allow your baby to learn this skill.
- Do not feed sweetened beverages to infants either in a bottle or a cup. These beverages include water sweetened with honey, sugar, or corn syrup; soda pop; sweetened iced tea; fruit drinks, punches, or aides; sweetened gelatin or other sweetened drinks. Baby should instead be fed more nutritious beverages that will help him or her grow, such as breast milk or infant formula (water and fruit juice can be fed, but in small amounts). If your baby is having diarrhea, contact your health care provider for advice on what to feed him or her to drink and eat.
- Do not leave a bottle in the baby's crib or playpen.
- Do not allow your baby to walk around or sit alone with a bottle for long periods.
- Offer the bottle only at feeding time, not when going to bed to sleep or for a nap. If your baby falls asleep during a feeding, move the baby around slightly to stimulate swallowing before putting him or her down to sleep.
- If you are having trouble getting your baby to stop taking a bedtime bottle, try showing your baby love in different ways besides the bedtime bottle; for example, give a security blanket or teddy bear, sing or play music, hold or rock your baby, or read a story to your baby.
- Never give your baby a pacifier dipped in honey, syrup, or sugar. Only give your baby a plain pacifier.
- Avoid giving baby any concentrated sweet foods, such as lollipops, sweet candies, candy bars, sweet cookies or cakes, or sweetened cereals, or adding sweeteners to baby's food.
- Start teaching your baby how to use a cup between ages 6 and 12 months. Try to wean your baby off the bottle entirely by about 12 months old. (Babies who stay on a bottle over 1 year old are more likely to get tooth decay.)
- Follow the advice of your medical or dental health care provider regarding your baby's fluoride needs.
- To discover and prevent tooth decay, take your baby to your health care provider or a pediatric dentist for a dental check by 1 year old. If your baby seems to have dental problems or decay before that age, take him or her to a health care provider as soon as possible.
- A mother with tooth decay may increase her baby's chances of getting tooth decay. Thus, try to:

  - Avoid sharing eating utensils or toothbrushes with your baby;
  - Do not chew food and then feed it to your baby;
  - Take care of your mouth with regular toothbrushing, flossing, and dental care; and
  - Obtain treatment for any tooth decay you have.

Teething Tips

- During teething, your baby's gums may be red and puffy and you may feel or see the new tooth coming out.
- To soothe baby's gums during teething, chill a clean favorite rattle, teething ring, pacifier, or a spoon in the refrigerator and offer it to baby to chew on. You can also try cleaning the baby's mouth 2 to 3 times per day with a clean damp gauze pad or washcloth.

- Do not offer your baby a bottle of cold juice, ice chips, or raw, hard vegetables like carrots; or rub alcohol on the baby's gums to soothe your teething baby.
- If your health care provider prescribes teething pain relief medicine, avoid giving it to baby before mealtime because it may interfere with chewing.

Cleaning the Mouth and Teeth

To keep your baby's teeth and gums clean and thus prevent tooth decay:

- **Before teeth appear**

  Clean your baby's mouth beginning from the first day of life. Wipe out the mouth gently and massage the gums with a clean damp gauze pad or washcloth after feedings or at least twice a day, including before bedtime. More frequent cleaning than twice a day may be recommended by a health care provider.

- **Once teeth appear**

  - Begin cleaning your baby's teeth as soon as they appear through the gums. Clean the teeth well after each feeding or at least twice a day, including before bedtime. More frequent cleaning than twice a day may be recommended by a health care provider, especially if your baby starts to develop tooth decay.
  - To clean the teeth, a very small, child-size toothbrush with soft, rounded-end bristles may be used with extreme care. Use water only, not toothpaste since a baby will swallow it. Continue using a clean damp gauze pad or washcloth to clean those areas in the mouth without teeth.
  - After your baby has some teeth (around 6 months old or later), he or she can be fed a small amount of water to drink after meals to clean away food from the mouth.

Sleeping or Resting Position

- Place your baby on his or her side or back to sleep or rest (whether after feeding or at bedtime), unless there is some medical reason not to. If your baby has a spitting up or vomiting problem, make sure to check with your health care provider about the correct sleeping position for your baby.

Physical Activity

- Encourage your baby to get physical activity appropriate for his or her development. For example, when a baby is ready to crawl, allow the baby to gain experience crawling; and when the baby is trying to walk, help the baby to begin to walk. These types of physical activity help the baby's body develop properly from infancy into childhood.

Appendix A

GROWTH CHARTS
WITH REFERENCE PERCENTILES
FOR BOYS
BIRTH TO 36 MONTHS OF AGE

Length for Age
Weight for Age
Head Circumference for Age
Weight for Length

NAME _____ **RECORD #** _____

DATE OF BIRTH _____

Date of Measurement	Age in Months	Recumbent Length	Weight	Head Circumference	

These charts to record the growth of the individual child were constructed by the National Center for Health Statistics in collaboration with the Center for Disease Control. The charts are based on data from the Fels Research Institute, Yellow Springs, Ohio. These data are appropriate for young boys in the general U.S. population. Their use will direct attention to unusual body size which may be due to disease or poor nutrition.

Measuring: Take all measurements with the child nude or with minimal clothing and without shoes. Measure length with the child lying on his back fully extended. Two people are needed to measure recumbent length properly. Use a beam balance to measure weight.

Recording: First take all measurements and record them on this front page. Then graph each measurement on the appropriate chart. Find the child's age on the horizontal scale; then follow a vertical line from that point to the horizontal level of the child's measurement (length, weight or head circumference). Where the two lines intersect, make a cross mark with a pencil. In graphing weight for length, place the cross mark directly above the child's length at the horizontal level of his weight. When the child is measured again, join the new set of cross marks to the previous set by straight lines.

Interpreting: Many factors influence growth. Therefore, growth data cannot be used alone to diagnose disease, but they do allow you to identify some unusual children.

Each chart contains a series of curved lines numbered to show selected percentiles. These refer to the rank of a measure in a group of 100. Thus, when a cross mark is on the 95th percentile line of weight for age it means that only five children among 100 of the corresponding age and sex have weights greater than that recorded.

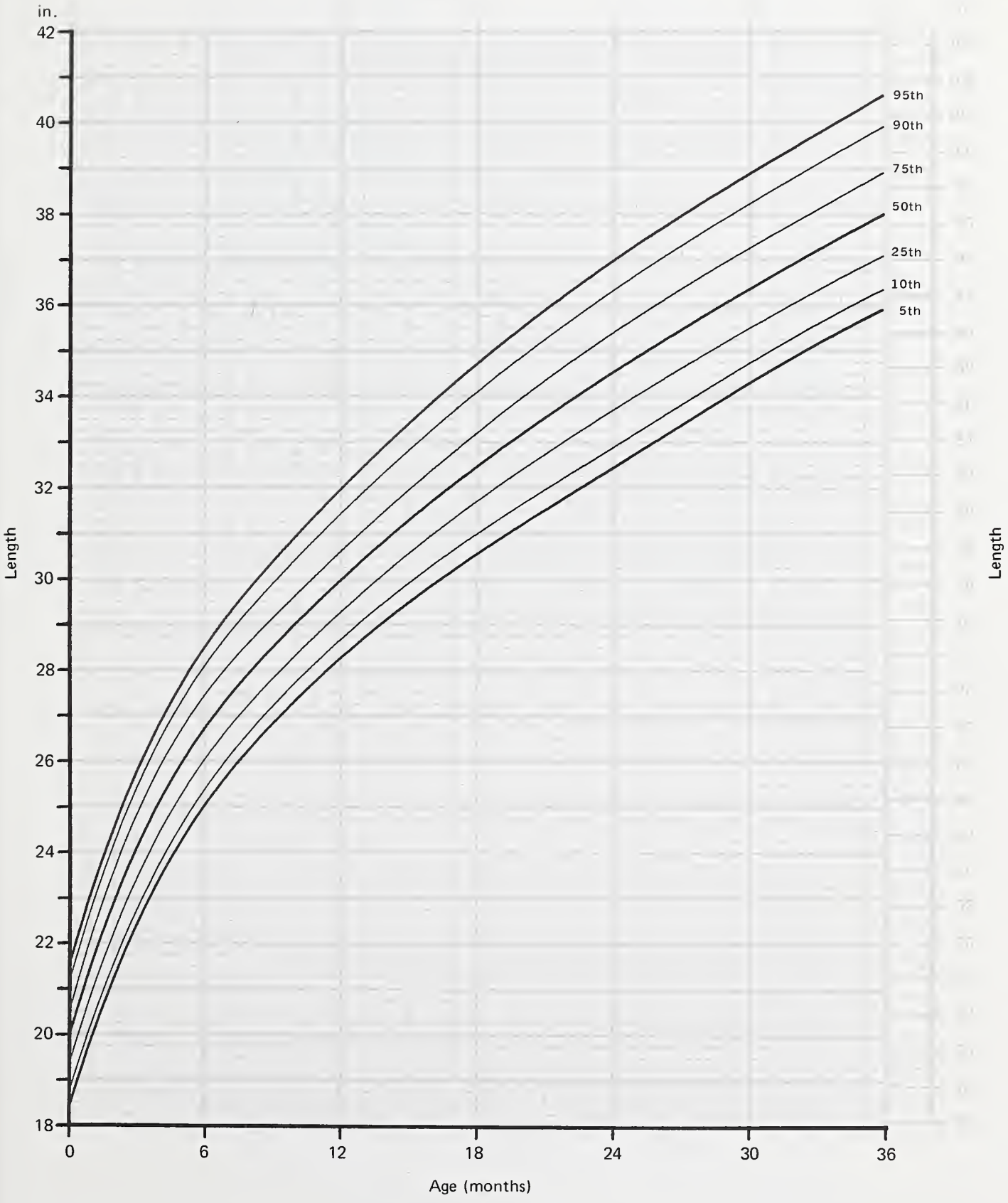
Inspect the set of cross marks you have just made. If any are particularly high or low (for example, above the 95th percentile or below the 5th percentile), you may want to refer the child to a physician. *Compare* the most recent set of cross marks with earlier sets for the same child. If he has changed rapidly in percentile levels, you may want to refer him to a physician. Rapid changes are less likely to be significant when they occur within the range from the 25th to the 75th percentile.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION, NATIONAL CENTER FOR HEALTH STATISTICS, AND CENTER FOR DISEASE CONTROL

Appendix A

BOYS FROM BIRTH TO 36 MONTHS

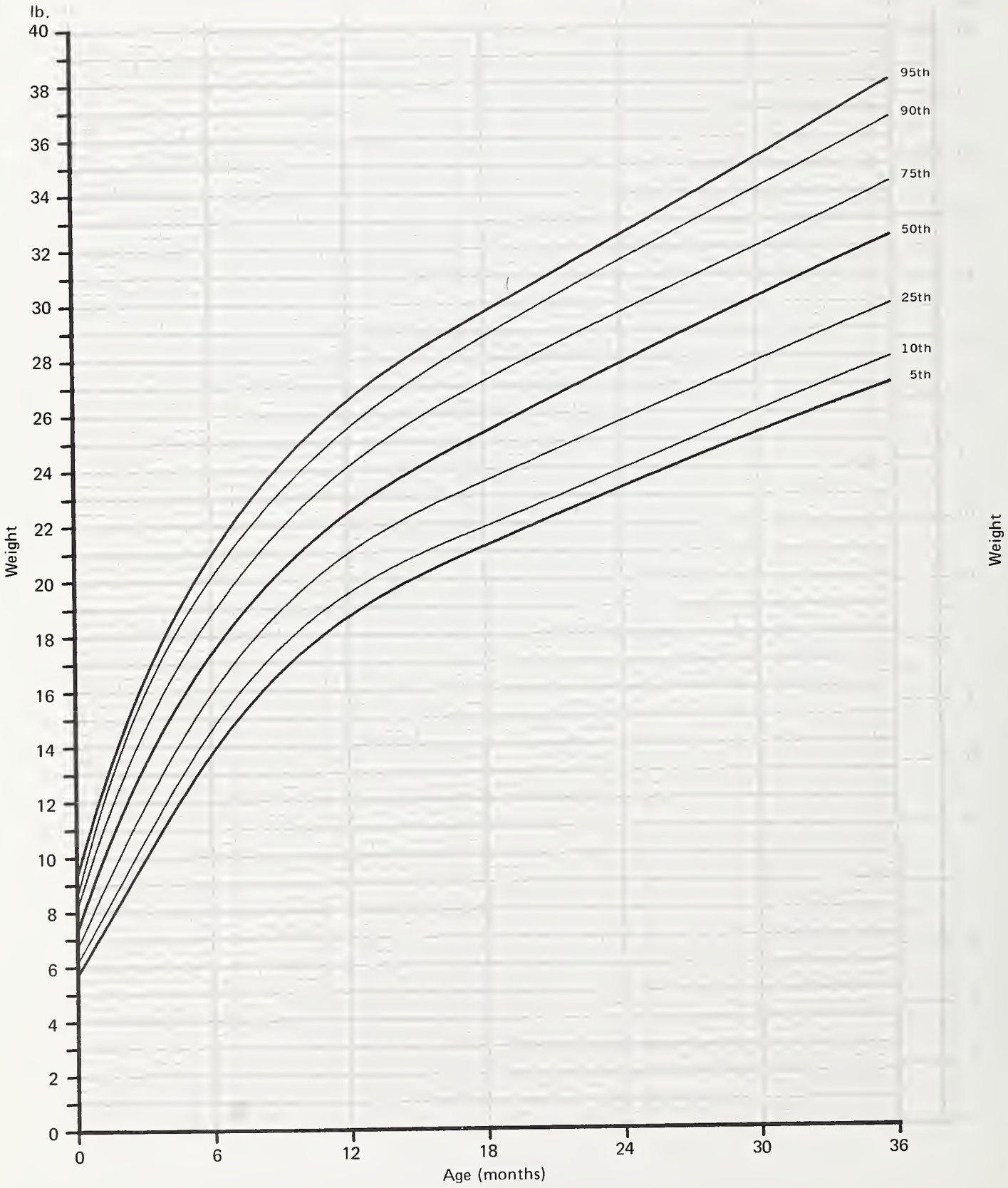
LENGTH FOR AGE



BOYS FROM BIRTH TO 36 MONTHS

Appendix A

WEIGHT FOR AGE



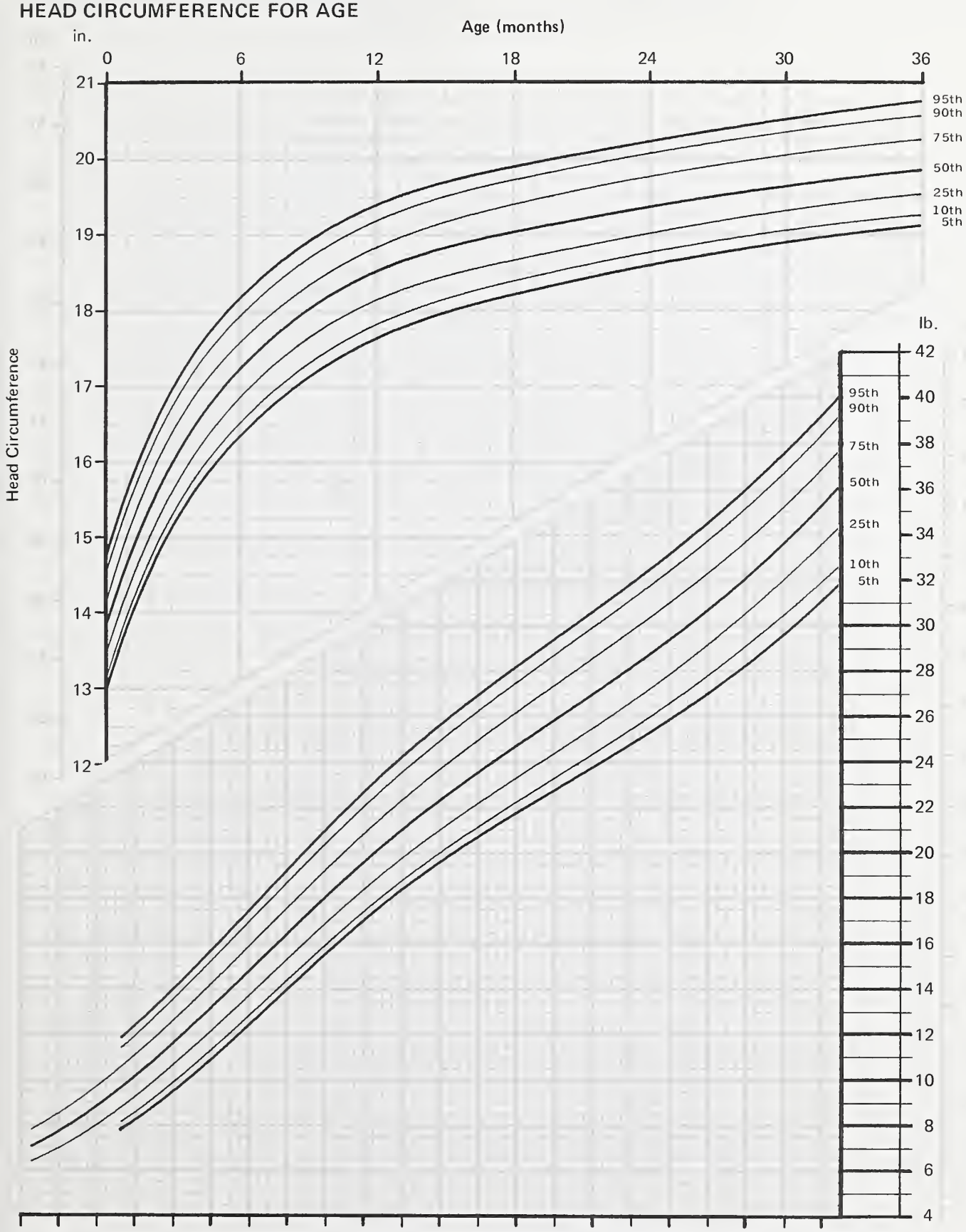
Weight

Head Circumference

Appendix A

BOYS FROM BIRTH TO 36 MONTHS

HEAD CIRCUMFERENCE FOR AGE



WEIGHT FOR LENGTH

Appendix A

GROWTH CHARTS
WITH REFERENCE PERCENTILES
FOR GIRLS
BIRTH TO 36 MONTHS OF AGE

Length for Age
Weight for Age
Head Circumference for Age
Weight for Length

NAME _____ RECORD # _____

DATE OF BIRTH _____

Date of Measurement	Age in Months	Recumbent Length	Weight	Head Circumference	

These charts to record the growth of the individual child were constructed by the National Center for Health Statistics in collaboration with the Center for Disease Control. The charts are based on data from the Fels Research Institute, Yellow Springs, Ohio. These data are appropriate for young girls in the general U.S. population. Their use will direct attention to unusual body size which may be due to disease or poor nutrition.

Measuring: Take all measurements with the child nude or with minimal clothing and without shoes. Measure length with the child lying on her back fully extended. Two people are needed to measure recumbent length properly. Use a beam balance to measure weight.

Recording: First take all measurements and record them on this front page. Then graph each measurement on the appropriate chart. Find the child's age on the horizontal scale; then follow a vertical line from that point to the horizontal level of the child's measurement (length, weight or head circumference). Where the two lines intersect, make a cross mark with a pencil. In graphing weight for length, place the cross mark directly above the child's length at the horizontal level of her weight. When the child is measured again, join the new set of cross marks to the previous set by straight lines.

Interpreting: Many factors influence growth. Therefore, growth data cannot be used alone to diagnose disease, but they do allow you to identify some unusual children.

Each chart contains a series of curved lines numbered to show selected percentiles. These refer to the rank of a measure in a group of 100. Thus, when a cross mark is on the 95th percentile line of weight for age it means that only five children among 100 of the corresponding age and sex have weights greater than that recorded.

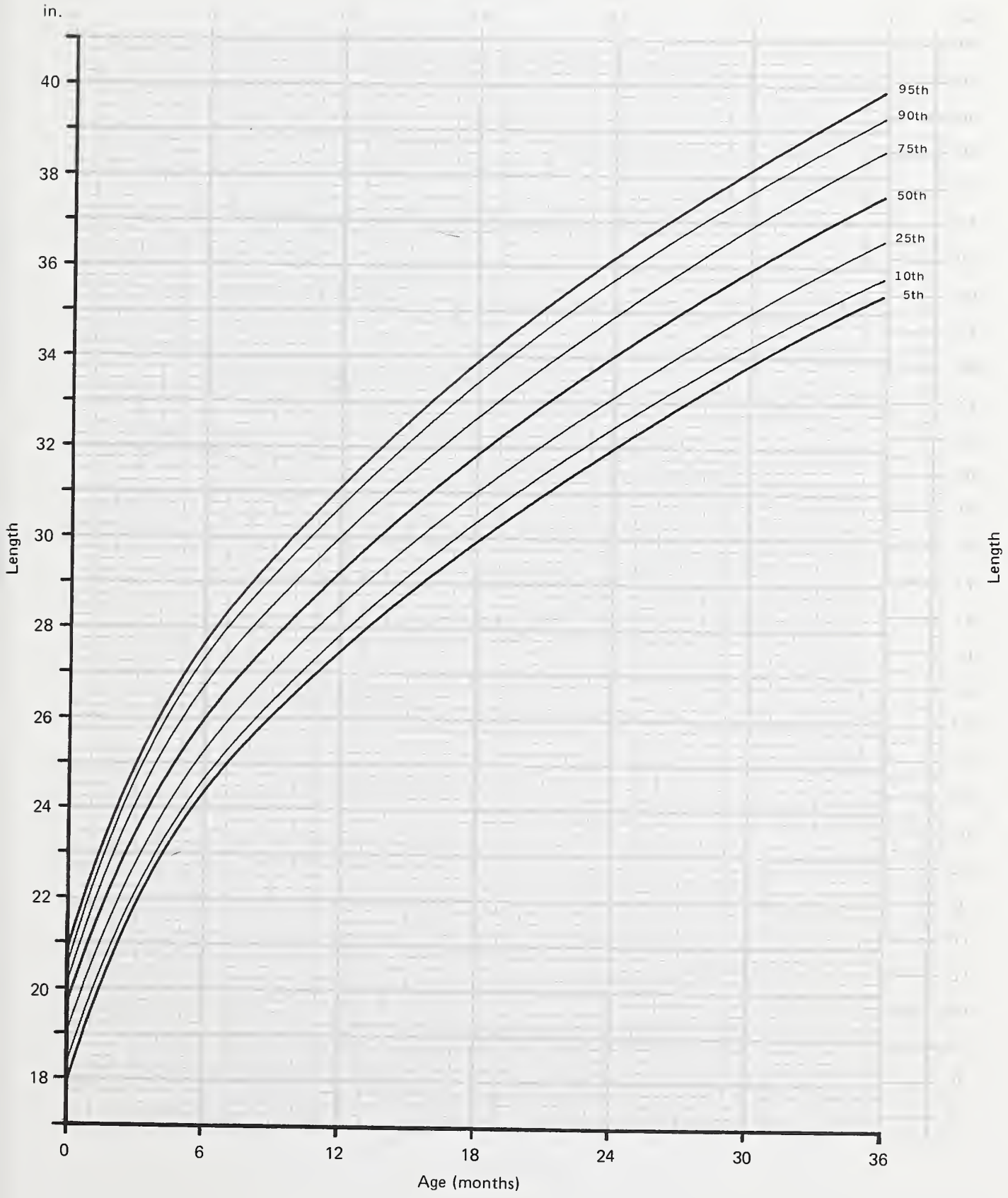
Inspect the set of cross marks you have just made. If any are particularly high or low (for example, above the 95th percentile or below the 5th percentile), you may want to refer the child to a physician. *Compare* the most recent set of cross marks with earlier sets for the same child. If she has changed rapidly in percentile levels, you may want to refer her to a physician. Rapid changes are less likely to be significant when they occur within the range from the 25th to the 75th percentile.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION, NATIONAL CENTER FOR HEALTH STATISTICS, AND CENTER FOR DISEASE CONTROL

Appendix A

GIRLS FROM BIRTH TO 36 MONTHS

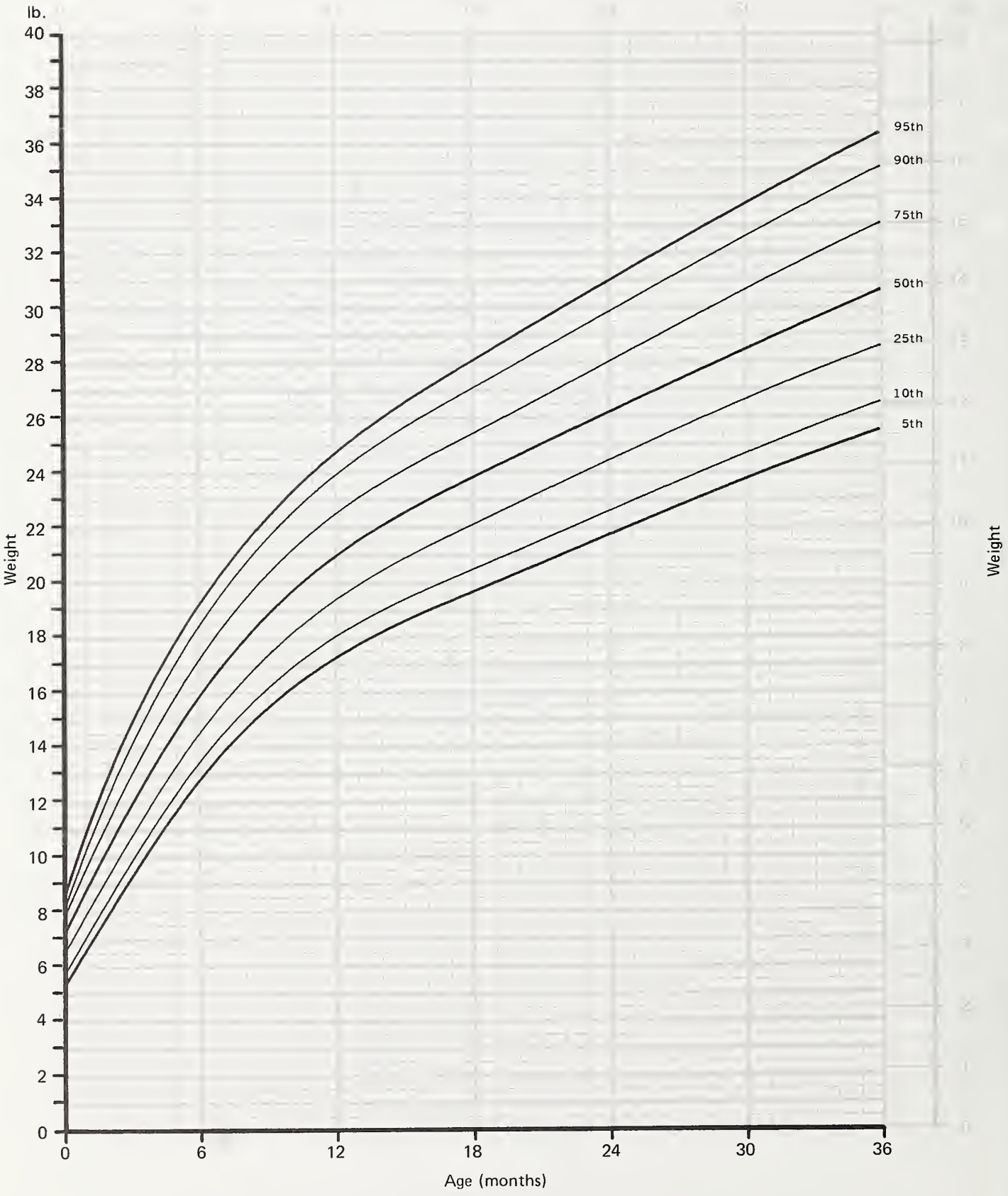
LENGTH FOR AGE



Appendix A

GIRLS FROM BIRTH TO 36 MONTHS

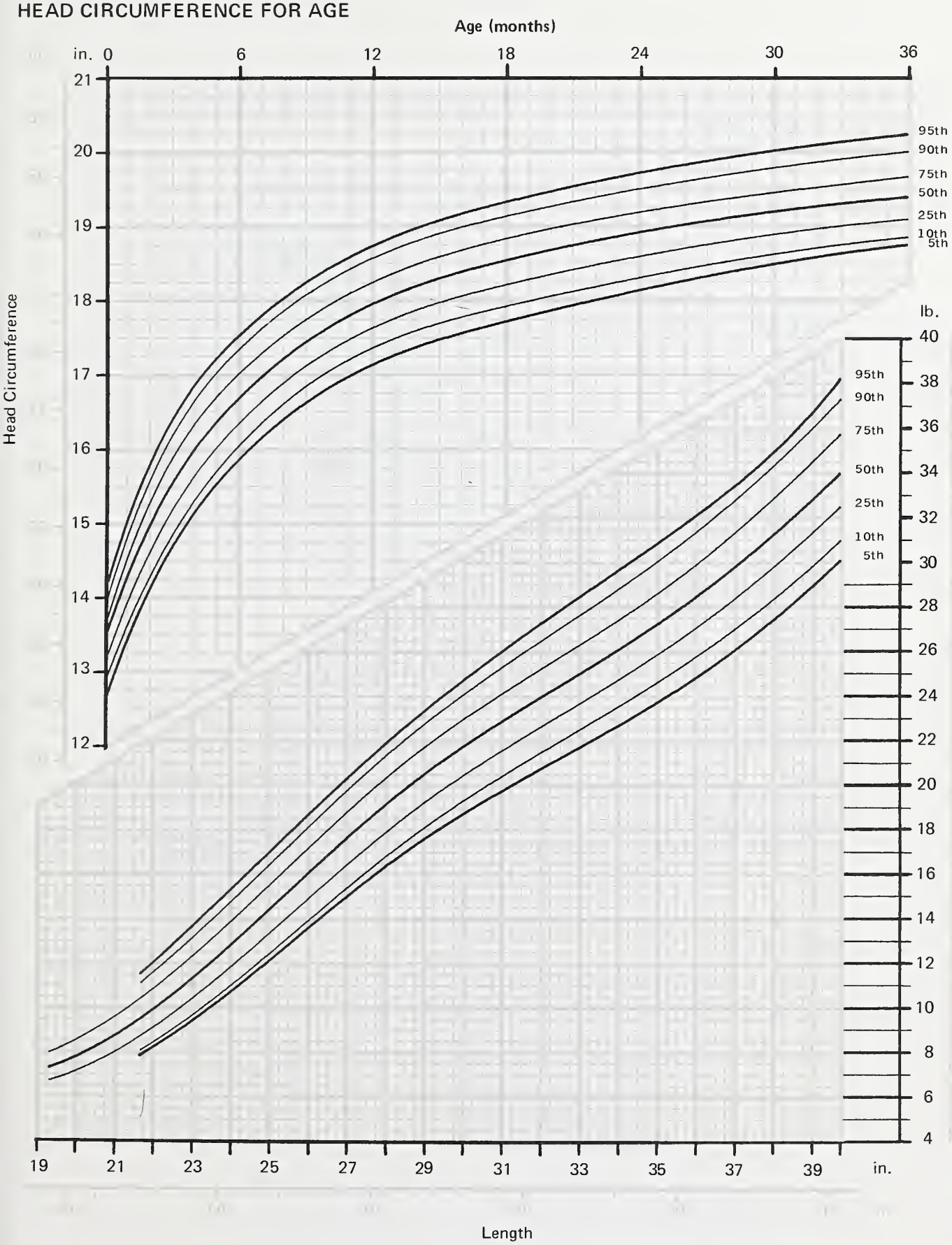
WEIGHT FOR AGE



Appendix A

GIRLS FROM BIRTH TO 36 MONTHS

HEAD CIRCUMFERENCE FOR AGE



WEIGHT FOR LENGTH

Appendix B: Table 1—Food and Nutrition Board, National Academy of Sciences—National Research Council Recommended Dietary Allowances,[a] Revised 1989

Designed for the maintenance of good nutrition of practically all healthy people in the United States

Category	Age (years) or Condition	Weight[b] (kg)	Weight[b] (lb)	Height[b] (cm)	Height[b] (in)	Protein (g)	Fat-Soluble Vitamins: Vitamin A (μg RE)[c]	Vitamin D (μg)[d]	Vitamin E (mg α-TE)[e]	Vitamin K (μg)
Infants	0.0-0.5	6	13	60	24	13	375	7.5	3	5
	0.5-1.0	9	20	71	28	14	375	10	4	10
Children	1-3	13	29	90	35	16	400	10	6	15
	4-6	20	44	112	44	24	500	10	7	20
	7-10	28	62	132	52	28	700	10	7	30
Males	11-14	45	99	157	62	45	1,000	10	10	45
	15-18	66	145	176	69	59	1,000	10	10	65
	19-24	72	160	177	70	58	1,000	10	10	70
	25-50	79	174	176	70	63	1,000	5	10	80
	51+	77	170	173	68	63	1,000	5	10	80
Females	11-14	46	101	157	62	46	800	10	8	45
	15-18	55	120	163	64	44	800	10	8	55
	19-24	58	128	164	65	46	800	10	8	60
	25-50	63	138	163	64	50	800	5	8	65
	51+	65	143	160	63	50	800	5	8	65
Pregnant						60	800	10	10	65
Lactating	1st 6 months					65	1,300	10	12	65
	2nd 6 months					62	1,200	10	11	65

[a] The allowances, expressed as average daily intakes over time, are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined. See NRC (1989) for detailed discussion of allowances and of nutrients not tabulated.

[b] Weights and heights of Reference Adults are actual medians for the U.S. population of the designated age, as reported by NHANES II. The median weights and heights of those under 19 years of age were taken from Hamill et al. (1979)*. The use of these figures does not imply that the height-to-weight ratios are ideal.

* Hamill, P.V.V., Drizd, T.A., Johnson, C.L., Reed, R.B., Roche, A.F., and Moore, W.M. Physical Growth: National Center for Health Statistics percentiles. **Am. J. Clin. Nutr.** 32: 607-629, 1979.

Adopted from table in: NRC (National Research Council): **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989.

Appendix B continued.

Water-Soluble Vitamins							Minerals						
Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg NE)[f]	Vitamin B_6 (mg)	Folate (μg)	Vitamin B_{12} (μg)	Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Iodine (μg)	Selenium (μg)
30	0.3	0.4	5	0.3	25	0.3	400	300	40	6	5	40	10
35	0.4	0.5	6	0.6	35	0.5	600	500	60	10	5	50	15
40	0.7	0.8	9	1.0	50	0.7	800	800	80	10	10	70	20
45	0.9	1.1	12	1.1	75	1.0	800	800	120	10	10	90	20
45	1.0	1.2	13	1.4	100	1.4	800	800	170	10	10	120	30
50	1.3	1.3	17	1.7	150	2.0	1,200	1,200	270	12	15	150	40
60	1.5	1.8	20	2.0	200	2.0	1,200	1,200	400	12	15	150	50
60	1.5	1.7	19	2.0	200	2.0	1,200	1,200	350	10	15	150	70
60	1.5	1.7	19	2.0	200	2.0	800	800	350	10	15	150	70
60	1.2	1.4	15	2.0	200	2.0	800	800	350	10	15	150	70
50	1.1	1.3	15	1.4	150	2.0	1,200	1,200	280	15	12	150	45
60	1.1	1.3	15	1.5	180	2.0	1,200	1,200	300	15	12	150	50
60	1.1	1.3	15	1.6	180	2.0	1,200	1,200	280	15	12	150	55
60	1.1	1.3	15	1.6	180	2.0	800	800	280	15	12	150	55
60	1.0	1.2	13	1.6	180	2.0	800	800	280	10	12	150	55
70	1.5	1.6	17	2.2	400	2.2	1,200	1,200	320	30	15	175	65
95	1.6	1.8	20	2.1	280	2.6	1,200	1,200	355	15	19	200	75
90	1.6	1.7	20	2.1	260	2.6	1,200	1,200	340	15	16	200	75

[c] Retinol equivalents. 1 retinol equivalent = 1 μg retinol or 6 μg β-corotene. See NRC (1989) for calculation of vitamin A activity of diets as retinol equivalents.

[d] As cholecolciferol. 10 μg cholecalciferol = 400 IU of vitamin D.

[e] α-Tocopherol equivalents. 1 mg d-α tocopherol = 1 α-TE. See NCR (1989) for variation in allowances and calculation of vitamin E activity of the diet as α-tocopherol equivalents.

[f] 1 NE(niocin equivalent) is equal to 1 mg of niocin or 60 mg of dietary tryptophan. *Appendix B continued.*

Appendix B: Table 2–Median Heights and Weights and Recommended Energy Intake

Category	Age (years) or Condition	Weight (kg)	Weight (lb)	Height (cm)	Height (in)	REE[a] (kcal/day)	Average Energy Allowance (kcal)[b] Multiples of REE	Average Energy Allowance (kcal)[b] Per kg	Average Energy Allowance (kcal)[b] Per day[c]
Infants	0.0-0.5	6	13	60	24	320		108	650
	0.5-1.0	9	20	71	28	500		98	850
Children	1-3	13	29	90	35	740		102	1,300
	4-6	20	44	112	44	950		90	1,800
	7-10	28	62	132	52	1,130		70	2,000
Males	11-14	45	99	157	62	1,440	1.70	55	2,500
	15-18	66	145	176	69	1,760	1.67	45	3,000
	19-24	72	160	177	70	1,780	1.67	40	2,900
	25-50	79	174	176	70	1,800	1.60	37	2,900
	51+	77	170	173	68	1,530	1.50	30	2,300
Females	11-14	46	101	157	62	1,310	1.67	47	2,200
	15-18	55	120	163	64	1,370	1.60	40	2,200
	19-24	58	128	164	65	1,350	1.60	38	2,200
	25-50	63	138	163	64	1,380	1.55	36	2,200
	51+	65	143	160	63	1,280	1.50	30	1,900
Pregnant	1st trimester								+0
	2nd trimester								+300
	3rd trimester								+300
Lactating	1st 6 months								+500
	2nd 6 months								+500

[a] Calculation based on FAO equations (Table 3-1),* then rounded.
[b] In the range of light to moderate activity, the coefficient of variation is ±20%.
[c] Figure is rounded.

* The FAO equations are found in: WHO (World Health Organization): 1985. **Energy and Protein Requirements. Report of a Joint FAO/WHO/UNU Expert Consultation.** Technical Report Series 724. World Health Organization, Geneva. 206 pp., and are reprinted in Table 3-1 in: NRC (National Research Council): **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989.

Adapted from table in: NRC (National Research Council): **Recommended Dietary Allowances, Report on the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989. *Appendix B continued.*

Appendix B: Table 3—Recommended Allowances of Reference Protein and U.S. Dietary Protein**

Category	Age (years) or Condition	Weight (kg)	Derived Allowance of Reference Protein[a] (g/kg)	(g/day)	Recommended Dietary Allowance (g/kg)[b]	(g/day)
Both sexes	0-0.5	6	2.20[c]		2.2	13
	0.5-1	9	1.56		1.6	14
	1-3	13	1.14		1.2	16
	4-6	20	1.03		1.1	24
	7-10	28	1.00		1.0	28
Males	11-14	45	0.98		1.0	45
	15-18	66	0.86		0.9	59
	19-24	72	0.75		0.8	58
	25-50	79	0.75		0.8	63
	51+	77	0.75		0.8	63
Females	11-14	46	0.94		1.0	46
	15-18	55	0.81		0.8	44
	19-24	58	0.75		0.8	46
	25-50	63	0.75		0.8	50
	51+	65	0.75		0.8	50
Pregnancy	1st trimester			+1.3		+10
	2nd trimester			+6.1		+10
	3rd trimester			+10.7		+10
Lactation	1st 6 months			+14.7		+15
	2nd 6 months			+11.8		+12

[a] Data from WHO (1985).*

[b] Amino acid score of typical U.S. diet is 100 for all age groups, except young infants. Digestibility is equal to reference proteins. Values have been rounded upward to 0.1 g/kg.

[c] For infants 0 to 3 months of age, breastfeeding that meets energy needs also meets protein needs. Formula substitutes should have the same amount and amino acid composition as human milk, corrected for digestibility if appropriate.

** Note: Equivalencies for Recommended Dietary Allowances for Protein in grams per pound of body weight are as follows:

Both sexes

Age (years)	
0-0.5	1.0 gram protein per pound of body weight
0.5-1	0.7 gram protein per pound of body weight

*WHO (World Health Organization). 1985. **Energy and Protein Requirements. Report of a Joint FAO/WHO/UNU Expert Consultation.** Technical Report Series 724. World Health Organization, Geneva. 206 pp.

Adapted from table in: NRC (National Research Council): **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989. *Appendix B continued.*

Appendix B: Table 4—Estimated Safe and Adequate Daily Dietary Intakes of Selected Vitamins and Minerals[a]

Category	Age (years)	Vitamins	
		Biotin (μ g)	Pantothenic Acid (mg)
Infants	0-0.5	10	2
	0.5-1	15	3
Children and adolescents	1-3	20	3
	4-6	25	3-4
	7-10	30	4-5
	11+	30-100	4-7
Adults		30-100	4-7

		Trace Elements[b]				
Category	Age (years)	Copper (mg)	Manganese (mg)	Fluoride (mg)	Chromium (μ g)	Molybdenum (μ g)
Infants	0-0.5	0.4-0.6	0.3-0.6	0.1-0.5	10-40	15-30
	0.5-1	0.6-0.7	0.6-1.0	0.2-1.0	20-60	20-40
Children and adolescents	1-3	0.7-1.0	1.0-1.5	0.5-1.5	20-80	25-50
	4-6	1.0-1.5	1.5-2.0	1.0-2.5	30-120	30-75
	7-10	1.0-2.0	2.0-3.0	1.5-2.5	50-200	50-150
	11+	1.5-2.5	2.0-5.0	1.5-2.5	50-200	75-250
Adults		1.5-3.0	2.0-5.0	1.5-4.0	50-200	75-250

[a] Because there is less information on which to base allowances, these figures are not given in the main table of RDA and are provided here in the form of ranges of recommended intakes.

[b] Since the toxic levels for many trace elements may be only several times usual intakes, the upper levels for the trace elements given in this table should not be habitually exceeded.

Adapted from table in: NRC (National Research Council): **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989. *Appendix B continued.*

Appendix B: Table 5—Estimated Sodium, Chloride, and Potassium Minimum Requirements of Healthy Persons[a]

Age	Weight (kg)[a]	Sodium (mg)[a, b]	Chloride (mg)[a, b]	Potassium (mg)[c]
Months				
0-5	4.5	120	180	500
6-11	8.9	200	300	700
Years				
1	11.0	225	350	1,000
2-5	16.0	300	500	1,400
6-9	25.0	400	600	1,600
10-18	50.0	500	750	2,000
>18[d]	70.0	500	750	2,000

[a] No allowance has been included for large, prolonged losses from the skin through sweat.
[b] There is no evidence that higher intakes confer any health benefit.
[c] Desirable intakes of potassium may considerably exceed these values (~3,500 mg for adults—see NRC (1989)).
[d] No allowance included for growth. Values for those below 18 years assume a growth rate at the 50th percentile reported by the National Center for Health Statistics (Hamill et al., 1979)* and averaged for males and females. See NRC (1989) for information on pregnancy and lactation.

* Hamill, P.V.V., Drizd, T.A., Johnson, C.L., Reed, R.B., Roche, A.F., and Moore, W.M. Physical Growth: National Center for Health Statistics percentiles. **Am. J. Clin. Nutr.** 32: 607-629, 1979.

Adapted from table in: NRC (National Research Council): **Recommended Dietary Allowances, Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commission on Life Sciences.** Washington, DC: National Academy Press, 1989.

Appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Protein	Anobolism of tissue proteins; helps mointoin fluid balance; energy source; formation of immunoglobulins; mointenance of ocid-bose balance; importont part of enzymes and hormones.	Kwoshiorkor—edemo; reddish pigmentotion of hoir and skin; fatty liver; retardotion of growth in children; diorrheo; dermatosis; decreosed T-cell lymphocytes with increosed secondary infections. Morasmus—muscle ond fat wosting; one-mio.	Azotemio; ocidosis; hyperommonemio.	Meat, fish, poultry, eggs, milk, cheese, dried beans ond peas, peanut butter, breast milk, infont formula.
Corbohydrote	Major energy source; protein sporing; necessory for normal fat metobolism; glucose is the sole source of energy for the broin; many sources olso provide dietary fiber.	Ketosis		Breods, cereol products, pototoes, corn, dried beons ond peos, fruit, sugar, milk, breast milk, infont formula.
Fat	Concentrated energy source; protein sporing; insulation for temperoture mointenonce; supplies essentiol fotty ocids; carries fot-soluble vitomins A, D, E, K.	Eczemo; low growth rate in infonts; lowered resistance to infection; hoir loss.		Protein-rich foods (meots, doiry products, nuts), breast milk, infant formulo, butter, morgarine, creom, solod oils and dressings, cooking ond meot fots.
Calcium	Builds ond maintains bones ond teeth; essentiol in clotting of blood; influences tronsmission of ions ocross cell membranes; required in nerve transmission.	Rickets—obnormol development of bones. Osteomalocio—failure to minerolize bone matrices; osteoporosis; tetony; possi-bly hypertension.	Excessive colcification of bone; calcificotion of soft tissue; hypercolcemio; vomiting; onorexia; lethorgy.	Milk, cheese, turnip and mustard greens, collords, kole, broccoli, sardines, salmon, herring, breost milk, infont formulo.
Chloride	Helps regulate ocid-bose equilibrium ond osmotic pressure of body fluids; component of gostric juices.	Usuolly accomponied by sodium depletion; see Sodium.		Sodium chloride (toble solt), breast milk, infant formulo.
Chromium	Required for normal glucose metobolism; insulin cofoctor.	Glucose intoleronce; impoired growth; peripherol neuropothy; negative nitrogen bolance; decreosed respirotory quotient.		Meat, cheese, whole grains, brewer's yeost.

Continued

Appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources—*Continued*

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Copper	Focilitotes the function of mony enzymes ond iron; moy be on integrol port of RNA, DNA molecules.	Foilure of iron obsorption; neutropenio; leukopenio; bone demineralizotion; foilure of erythropoiesis; in infonts—pollor, retorded growth, edemo, onorexio.	Wilson's diseose—copper deposits in the corneo; cirrhosis of liver; deteriorotion of neurologicol processes.	Liver, kidney, shellfish, nuts, legumes, roisins, chocolate.
Iodine	Helps regulote thyroid hormones; importont in regulotion of cellulor oxidotion ond growth.	Endemic goiter; depressed thyroid function; cretinism.	Possible thyroid enlorgement.	Breost milk, infont formulo, seofood, iodized solt.
Iron	Essentiol for the formotion of hemoglobin ond oxygen tronsport; increoses resistonce to infection; functions os port of enzymes involved in tissue respirotion.	Hypochromic microcytic onemio; molobsorption; irritobility; onorexio; pollor; lethorgy.	Hemochromotosis; hemosiderosis.	Liver, leon meot, poultry, oysters, dried beons, fortified cereols, dork molosses, breost milk, infont formulo.
Fluoride	Helps protect teeth ogoinst tooth decoy; moy minimize bone loss.	Increosed dentol cories.	Mottled, discolored teeth; possible increose in bone density; colcified muscle insertions ond exotosis.	Fluoridoted woter.
Mognesium	Required for mony coenzyme oxidotion-phosphorylotion reoctions, nerve impulse tronsmissions, ond for muscle controction.	Muscle tremors; convulsions; irritobility; tetony; hyper- or hypoflexio.	Diorrheo; tronsient hypocolcemio.	Whole groins, nuts, dried beons ond peos, breost milk, infont formulo.
Mongonese	Essentiol port of severol enzyme systems involved in protein ond energy metobolism ond in the formotion of mucopolysocchoride.	Impoired growth; skeletol obnormolities; lowered reproductive function; neonotol otoxio.	In extremely high exposure from contominotion: severe psychiotric ond neurologic disorders.	Whole groins ond cereol products, dried fruits, fruits ond vegetobles (leofy), nuts.
Molybdenum	Port of the enzymes xonthine oxidose ond oldehyde oxidose; possibly helps reduce incidence of dentol cories.		Goutlike syndrome.	Meot, beef kidney, dependent on soil content where grown—cereol groins, legumes.
Phosphorus	Builds ond mointoins bones ond teeth; component of nucleic ocids, phospholipids; os coenzyme functions in energy metobolism; buffers introcellulor fluid.	Phosphote depletion unusuol—effects renol, neuromusculor, skeletol systems os well os blood chemistries.	Hypocolcemio (when porothyroid glond not fully functioning).	Meot, poultry, fish, eggs, milk, nuts, legumes, breost milk, infont formulo.

Continued

Appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources—*Continued*

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Potassium	Helps regulate acid-base equilibrium and osmotic pressure of body fluids; influences muscle activity, especially cordioc muscle.	Muscle weakness; decreased intestinal tone and distension; cardiac arrhythmias; respiratory foilure.		Fruits, especiolly orange juice, banonas, ond dried fruits, pototoes, milk, meat, breast milk, infont formula.
Selenium	Moy be essential to tissue respirotion; associated with fat metabolism and vitamin E.	Myalgia; muscle tenderness; cordioc myopothy; increosed fragility of red blood cells; degenerotion of pancreas.		Groin products, onions, meat, seafood, liver, milk, dependent on soil content—vegetables.
Sodium	Helps regulate acid-base equilibrium ond osmotic pressure of body fluids; plays a role in normal muscle irritability and controctility; influences cell permeability.	Nouseo; cramps; vomiting; dizziness; apathy; exhoustion; possible respiratory failure.		Sodium chloride (toble salt), abundont in most foods except fruit.
Zinc	Component of mony enzyme systems ond of insulin.	Decreased wound heoling; in children—hypogonadism, mild onemio, decreased taste ocuity, hair loss, diorrhea, growth foilure, skin chonges.	Acute gostrointestinal upset; vomiting; sweoting; dizziness; copper deficiency.	Meat, liver, eggs, oysters, ond other seafood, whole grains, legumes, some cheeses, breost milk, infont formula.
Vitomin A	Preserves integrity of epithelial cells; formation of rhodopsin for vision in dim light; necessary for wound healing, growth, and normol immune function.	Graduol loss of or dim vision; dry eyes; Bitot's spots; papillory hyperkerotosis of the skin; advonced deficiency—corneol softening ond liquefoction.	Fotigue; night sweats; vertigo; headache; dry ond fissured skin, lips; hyperpigmentation; retorded growth; bone poin; obdominol poin; vomiting; joundice; hypercalcemio.	Liver, egg yolk, milk, butter, dark green ond deep yellow vegetables, breost milk, infont formula.
Vitamin D	Necessary for the formation of normal bone; promotes the obsorption of colcium, phosphorus in the intestines.	In infonts ond children—rickets (symptoms: costochondral beading, epiphyseal enlorgement, cronial bossing, bowed legs, persistently open anterior fontonelle); adults—osteomalocia.	In infonts—obnormally high blood calcium, anorexia, retarded growth; in odults—sudden anorexia, nouseo, vomiting, polydipsio, polyuria, calcificotion of soft tissue.	Eggs, liver, fotty fish, butter, fortified milk, cod liver oil, infont formula, sunlight (octivotion of 7-dehydrocholesterol in the skin).
Vitamin E	May function as an ontioxidont in the tissues; may also hove o role os a coenzyme; neuromusculor function.	Hemolytic anemia in the premature ond newborn; increased red blood cell hemolysis; muscle lesions; creatinurea; ceroid pigment deposition.	May interfere with vitomin K activity leading to prolonged clotting ond bleeding time; in onemia, suppresses the normal hemotologic response to iron.	Vegetoble oils, beef liver, milk, eggs, butter, leafy vegetables, fortified cereals, breast milk, infant formulo.

Continued

Appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources—*Continued*

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Vitomin K	Cotolyzes prothrombin synthesis; required in the synthesis of other blood clotting foctors.	Prolonged bleeding ond prothrombin time; hemorrhogic monifestotions (especiolly in newborns).	Possible hemolytic onemio; kernicterus in infonts.	Vegetoble oils, green leofy vegetobles, liver, cereols, doiry products, breost milk, infont formulo. Synthesized by normol intestinol bocterio.
Ascorbic Acid Vitomin C	Essentiol in the synthesis of collogen (thus, strengthens tissues ond improves wound heoling ond resistonce to infection); ploys o role in the synthesis of corticosterone ond 17-hydroxy-corticosterone; enhonces iron obsorption from the GI troct; is o woter-soluble ontioxidont ond thus protects other lipid-soluble vitomins.	Scurvy—diffuse tissue bleeding, pinpoint peripherol hemorrhoges, eosy bone frocture, joint bleeds, poor wound heoling, frioble bleeding gums with loose teeth.	Nouseo; obdominol cromps; diorrheo; possible formotion of kidney stones; possible deregulotion of ocid-bose bolonce; possible destruction of vitomin B_{12}.	Fruits, especiolly citrus fruits, tomatoes, peppers, leofy vegetobles, greens, row cobboge, breost milk, infont formulo.
Thiomin Vitomin B_1	Combines with phosphorus to form thiomin pyrophosphote (TPP) necessory for metobolism of protein, corbohydrote, ond fot; moy hove o specific role in neurophysiology.	Wet beriberi—high output congestive heort foilure, cordiomyopothy, tochycordio, peripherol edemo. Dry beriberi—weokness, poresthesios, loss of deep tendon reflexes, possible otrophic, tender muscles, possible foot-drop, wristdrop.		Pork, wheot germ, whole- ond enriched groin products, breost milk, infont formulo.
Riboflovin Vitomin B_2	Port of the flovin coenzymes; required in tissue oxidotion ond respirotion; essentiol for growth.	Photophobio; loss of visuol ocuity; burning ond itching eyes; chelosis; ongulor stomotitis; glossitis; seborrheic dermotitis.		Milk, cheese, eggs, orgon meots, lomb, pork, green leof vegetobles, breost milk, infont formulo.
Niocin	Port of the enzyme system for oxidotion, energy releose; necessory for synthesis of glycogen ond the synthesis ond breok-down of fotty ocids.	Pellegro—opothy, onorexio, symmetric dermotosis especiolly in sun-exposed oreos of the skin; peripherol neuropothy; encepholopothy with some degree of dementio; diorrheo secondory to otrophic chonges in the GI troct.	Tronsient due to the vosodiloting effects of niocin (does not occur with niocinomide)—flushing, tingling, dizziness, nouseo.	Leon meots, poultry, peonuts, orgon meots, fish, brewer's yeost, fortified cereol products, breost milk, infont formulo.

Continued

Appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources—*Continued*

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Vitamin B_6	Criticol to protein synthesis; possibly involved in central nervous system metabolism; ploys o role in hemoglobin synthesis.	Microcytic hypochromic anemia with high serum iron; weakness; nervousness; insomnia; glossitis; stomatitis; chelosis; vomiting; hyperirritability; abdominal distress; loss of weight; convulsions.	Sensory neuropothy with progressive otaxio; oltered sense of touch, temperoture, ond poin.	Yeast, wheat germ, meat, liver, fish, poultry, legumes, potatoes, banonas, whole-groin cereals, breast milk, infont formulo.
Folacin	Essentiol in the biosynthesis of purine and pyrimidine; necessary for the normol maturation of red blood cells.	Poor growth; megaloblastic anemio; glossitis; stomatitis; ond GI disturbances. With megaloblostic anemia o concurrent deficiency of vitomin B_{12} should be suspected.		Liver, green leofy vegetables, legumes, asporogus, broccoli, whole-grain cereals, nuts, oronge ond grapefruit juices, breast milk, infont formula.
Vitamin B_{12} Cobalomin, cyonocobalamin	Essentiol to normal red blood cell formation and nucleic ocid synthesis; offects nervous system probably through its role in glucose metabolism; involved in single corbon metobolism.	Megoloblastic anemia; progressive neurologic deteriorotion secondory to demyelinotion of lorge nerve fibers of the spinal cord.		Meot, liver, kidney, eggs, cheese, fish, breast milk, infant formulo.
Pantothenic Acid	Participates in energy releose from protein, corbohydrate, and fot; required in the biosynthesis of fatty ocids.	Fatigue; sleep disturbonces; personality changes; nouseo; muscle cromps; tingling in hands ond feet; impaired coordinotion; loss of ontibody production.	Diorrhea; water retention.	Meat, fish, poultry, liver, kidney, egg yolk, yeost, whole grains, legumes, fresh vegetables, breost milk, infont formulo.
Biotin	Importont in reoctions involving the lengthening of carbon chains; coenzyme carrier of corbon dioxide; plays an important role in the metabolism of fat ond carbohydrate.	Lenier's dermotitis or, in infants, seborrheic dermotitis; glossitis; onorexia; nausea; insomnio; thin hair.		Liver, kidney, milk, egg yolk, yeast, mushrooms, banonas, strowberries, grapefruit, wotermelon, breast milk, infont formulo.

Nutrient Chart Bibliography:
Beaudette, T., ed. Vitamin supplementotion: risks ond benefits. *Semin Nutr.* 5: 6, 1986.
Krouse, M.V. ond Mahon, L.K. *Food, Nutrition, and Diet Therapy.* 7th ed. Philodelphio, PA: W.B. Sounders, 1984.
Schneider, H.A., Anderson, C.E., ond Coursin, D.B. *Nutritionol Support of Medical Practice.* 2nd ed. Philodelphio, PA: Harper and Row,1983.
Whitney, E.N. ond Cataldo, C.B. *Understanding Normal ond Clinical Nutrition.* St. Poul, MN: West Publishing Co., 1983.

Chort odopted using additionol reference materiol from: Hendricks, K.M. ond Wolker, W.A. Monual of Pediotric Nutrition. 2nd ed. Philodephio, PA: B.C. Decker, Inc., 1990. This materiol used by permission of Mosby-Yeor Book, Inc.

Appendix D

What Can You Do When A Child Is Choking?

If a conscious child is choking but CAN BREATHE:

Call the rescue squad and until help comes:
- Keep the child calm.
- Have the child sit down and cough.
- Do not slap the child on the back.
- Do not give the child a drink.
- Do not hold the child upside down.

If a conscious child is choking but CANNOT BREATHE, COUGH, SPEAK, OR CRY:

Call the rescue squad and until help comes:
- For an **infant who is conscious**
  1. Place the infant face down on your arm, supported by your thigh. Support the head and neck.
  2. Give five back blows between the shoulder blades with the heel of your hand.

If the object does not come out:
  3. Sandwich the infant between your forearms and hands, and turn the infant on its back.
     Place your arm on your thigh for support. Support the head and neck.
  4. Give five chest thrusts on about the center of the breastbone.
  5. Repeat if necessary.

- For a **young child who is conscious**
  1. Lay the child on the floor on its back. Kneel at the child's feet.
  2. Place the heel of one hand against the middle of the child's stomach, just above the navel.
     DO NOT PRESS YOUR FINGERS ON THE CHILD'S RIBS.
  3. Give up to five abdominal thrusts.
  4. Repeat if necessary.

If a choking infant or young child BECOMES UNCONSCIOUS:

1. Open the mouth and look for the object. If you can see it, remove it by doing a finger sweep with your little finger.
2. Give two slow breaths to the infant or young child.
3. Repeat the steps given above for a conscious infant or young child if necessary.

THE INFANT OR CHILD NEEDS TO SEE A DOCTOR, EVEN WHEN THE OBJECT COMES OUT AND BREATHING RETURNS.

Everyone should learn how to do these lifesaving steps.
Call your local American Red Cross chapter for first aid training information.

DO NOT PRACTICE ON PEOPLE.

This figure courtesy of the American Red Cross, Washington, D.C.

Selected Bibliography

Selected Textbooks With Focus or Sections on Pediatric Nutrition

American Dietetic Association. **Manual of Clinical Dietetics.** Chicago, IL: The American Dietetic Association, 1992.

Committee on Nutrition, American Academy of Pediatrics. **Pediatric Nutrition Handbook.** Elk Grove Village, IL: American Academy of Pediatrics, 1993.

DHHS (U.S. Department of Health and Human Services). **Infant Care.** Washington, DC: U.S. Government Printing Office, 1989.

DHHS (U.S. Department of Health and Human Services). **The Surgeon General's Report on Nutrition and Health.** Washington, DC: U.S. Government Printing Office, 1988.

Fomon, S.J. **Nutrition of Normal Infants.** St. Louis, MO: Mosby, 1993.

Grand, R.J., Sutphen, J.L., and Dietz, W.H. **Pediatric Nutrition: Theory and Practice.** Boston, MA: Butterworth Publishers, 1987.

Hendricks, K.M. and Walker, W.A. **Manual of Pediatric Nutrition.** 2nd ed. Philadelphia, PA: BC Decker, Inc., 1990.

Howard, R.B. and Winter, H.S. **Nutrition and Feeding of Infants and Toddlers.** Boston, MA: Little, Brown and Company, 1984.

Pemberton, C.M., et al. **Mayo Clinic Diet Manual:** A Handbook of Dietary Practices. Toronto, Canada: B.C. Decker Inc., 1988.

Pipes, P.L. and Trahms, C.M. **Nutrition in Infancy and Childhood.** St. Louis, MO: Mosby—Year Book, Inc., 1993.

Queen, P.M. and Lang, C.E. **Handbook of Pediatric Nutrition.** Gaithersburg, MD: Aspen Publishers, Inc., 1993.

Satter, E. **Child of Mine: Feeding with Love and Good Sense.** Palo Alto, CA: Bull Publishing Co., 1986.

Satter, E. **How to Get Your Kid to Eat—But Not Too Much.** Palo Alto, CA: Bull Publishing Co., 1987.

Simko, M.D., Cowell, C., and Hreha, M.S. **Practical Nutrition: A Quick Reference for the Health Care Practitioner.** Rockville, MD: Aspen Publishers, Inc., 1989.

Suskind, R.M. **Textbook of Pediatric Nutrition.** New York, NY: Raven Press, 1981.

Tsang, R.C. and Nichols, B.L. **Nutrition During Infancy.** St. Louis, MO: C.V. Mosby Co., 1988.

Twin Cities District Dietetic Association. **Manual of Pediatric Nutrition.** Minneapolis, MN: DCI Publishing, 1990.

Walker, W.A. and Watkin, J. **Nutrition in Pediatrics.** Boston, MA: Little, Brown, 1986.

Wallace, H.M., Ryan, G., and Oglesby, A.C. **Maternal and Child Health Practices,** 3rd. ed. Oakland, CA: Third Party Publishing Co., 1988.

Winick, M. **Nutrition, Pregnancy, and Early Infancy.** Baltimore, MD: Williams and Wilkins, 1989.

Worthington-Roberts, B.S., Vermeersch, J., and Williams, S.R. **Nutrition in Pregnancy and Lactation.** 4th ed. St. Louis, MO: C.V. Mosby Co., 1989.

Selected References on Nutrition Care for Children with Developmental Disabilities

Anderson, P.P. and Fenichel, E.S. **Serving Diverse Families of Infants and Toddlers with Disabilities.** Washington, DC: National Center for Clinical Infant Programs, 1989.

Brizee, L.S., McLaughlin, J.F., and Sophos, C.M. **Nutrition Guidelines for Children with Disabilities and Chronic Illnesses.** Seattle, WA: Washington State Department of Social and Health Services, 1989.

CHEWS Nutrition Project, Nutrition Bureau, Public Health Division. **Nutrition Screening for Children with Special Needs.** Santa Fe, NM: Health and Environment Department, 1988.

Cloud, H.H. Developmental disabilities. In: Queen, P.M. and Lang, C.E. **Handbook of Pediatric Nutrition.** Gaithersburg, MD: Aspen Publishers, Inc., 1993.

Crump, I.M. **Nutrition and Feeding of the Handicapped Child.** Boston, MA: Little, Brown, and Co., 1987.

McClanahan, C. **Feeding and Caring for Infants and Children with Special Needs.** Rockville, MD: American Occupational Therapy Association, 1987.

Morris, S.E. and Klein, M.D. **Pre-Feeding Skills: A Comprehensive Resource for Feeding Development.** Tucson, AZ: Therapy Skill Builders, 1987.

Nutrition focus: For children with special health care needs. (a newsletter on nutrition issues facing children with developmental disabilities/chronic illnesses) Seattle WA: Child Development and Mental Retardation Center, University of Washington, Seattle, WA.

Palmer, S. and Ekvall, S. **Pediatric Nutrition in Developmental Disorders.** Springfield, IL: Charles C. Thomas Co., 1978.

Pipes, P.L. and Glass, R.P. Developmental disabilities and other special health care needs. In: Pipes, P.L. and Trahms, C.M. **Nutrition in Infancy and Childhood.** St. Louis, MO: Mosby—Year Book, Inc., 1993.

Rokursek, C. and Heindicles, E. **Nutrition and Feeding for the Developmentally Disabled.** Vermillion, SD: South Dakota Department of Education and Cultural Affairs, 1985.

Smith, M.A. **Feeding the Handicapped Child.** The University of Tennessee Child Development Center, 711 Jefferson Ave., Memphis, TN 38105.

Selected References on Breastfeeding Promotion

Committee on Nutrition, American Academy of Pediatrics. Encouraging breastfeeding. **Pediatrics** 65: 657-658, 1980.

Committee on Nutrition, American Academy of Pediatrics, Task Force on Promotion of Breastfeeding. The promotion of breastfeeding. **Pediatrics** 69: 654-661, 1982.

American Dietetic Association. Position of the American Dietetic Association Promotion of breastfeeding. **J. Amer. Dietet. Assoc.** 93: 467-469, 1993.

Spisak, S. and Gross, S.S. **Second followup report: The Surgeon General's Workshop on Breastfeeding and Human Lactation.** Washington, DC: National Center for Education in Maternal and Child Health, 1991.

U.S. Department of Agriculture. **WIC Breastfeeding Promotion Study and Demonstration, Phase IV Report, Volumes I and II.** Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service, 1990.

U.S. Department of Agriculture. **Promoting Breastfeeding in WIC: A Compendium of Practical Approaches,** FNS-256. Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service, 1988.

U.S. Department of Agriculture, Food and Nutrition Service. **Promoting Breastfeeding: A Guide for Health Professionals Working in the WIC and CSF Programs (FNS-247).** Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service, 1984.

U.S. Department of Health and Human Services, Division of Maternal and Child Health. **Report of the Surgeon General's Workshop on Breastfeeding and Human Lactation.** U.S.D.H.H.S., Public Health Service, Bureau of Maternal and Child Health (DHHS Pub. No. HRS-D-MC 84-2) Washington, DC, 1984.

U.S. Department of Health and Human Services, Division of Maternal and Child Health. **First Followup Report: The Surgeon General's Workshop on Breastfeeding and Human Lactation.** DHHS, Public Health Service, Bureau of Maternal and Child Health (DHHS Pub. No. HRS-D-MC 85-2) Washington, DC, 1986.

National Association of WIC Directors. **Guidelines for Breastfeeding Promotion in the WIC Program,** National Association of WIC Directors, 1990.

Selected References Relating to Breastfeeding and Lactation Management

Committee on Drugs, American Academy of Pediatrics. Transfer of drugs and other chemicals into human milk. **Pediatrics** 84: 924- 936, 1989.

Briggs, G., Freeman, R., and Yaffe, S. **Drugs in Pregnancy and Lactation.** Baltimore, MD: Williams and Wilkins, 2nd ed., 1986.

Dana, N. and Price, A. **The Working Woman's Guide to Breastfeeding.** Deephaven, MN: Meadowbrook, Inc., 1987.

Eiger, M.S. and Olds, S.W. **The Complete Book of Breastfeeding.** New York, NY: Bantam Books, 1987.

Goldfarb, J. and Tibbetts, E. **Breastfeeding Handbook: A Practical Reference for Physicians, Nurses, and Other Health Professionals.** Hillside, NJ: Enslow Pub., 1980.

Grams, M. **Breastfeeding Source Book: Where to Get What You Need to Breastfeed Successfully.** Sheridan, WY: Achievement Press, 1988.

Grams, M. **Breastfeeding Success for Working Mothers.** Sheridan, WY: Achievement Press, 1986.

Kitzinger, S. **Breastfeeding Your Baby.** New York, NY: Alfred A. Knopf, 1989.

Huggins, K. **The Nursing Mothers' Companion.** Boston, MA: The Harvard Common Press, 1990.

Institute of Medicine. **Nutrition During Lactation. Report of the Subcommittee on Nutrition During Lactation, Food and Nutrition Board, Institute of Medicine.** Washington, DC: National Academy Press, 1991.

Jolley, S. **Breastfeeding Triage Tool.** Seattle, WA: Seattle-King County Department of Health, 1988.

La Leche League. **The Womanly Art of Breastfeeding.** Franklin Park, IL: La Leche International, 1991.

Lauwers, J. and Woessner, C. **Counseling the Nursing Mother: A Reference Handbook for Health Care Providers and Lay Counselors.** 2nd ed., Garden City Park, NY: Avery Publishing Group, Inc., 1989.

Lawrence, R.A. **Breastfeeding: A Guide for the Medical Profession.** 3rd ed. St. Louis, MO: The C.V. Mosby Company, 1989.

Mason, D. and Ingersoll, D. **Breastfeeding and the Working Mother.** New York, NY: St. Martin's Press, 1986.

Mohrbacher, N. and Stock, J. **The Breastfeeding Answer Book.** Franklin Park, IL: La Leche League International, 1991.

Neville, B. and Neifert, M. **Lactation, Physiology, Nutrition and Breastfeeding.** New York, NY: Plenum Press, 1983.

Presser, J. and Brewer, G.S. **Breastfeeding.** New York, NY: Alfred A. Knopf, 1983.

Renfrew, M., Fisher, C., and Arms, S. **Bestfeeding: Getting Breastfeeding Right For You.** Berkeley, CA: Celestial Arts, 1990.

Reukauf, D. and Trause, M.A. **Commonsense Breastfeeding: A Practical Guide to the Pleasures, Problems and Solutions.** New York, NY: Macmillan Publishing Co., Inc., 1988.

Riordan, J. **A Practical Guide to Breastfeeding.** St. Louis, MO: The C. V. Mosby Company, 1983.

Riordan, J. and Auerbach, K.G. **Breastfeeding and Human Lactation.** Boston, MA: Jones and Bartlett Publishers, 1993.

Saunders, S., Carroll, J.M., and Johnson, C.E. **Breastfeeding: A Problem-Solving Manual.** 2nd ed. Amityville, NY: Essential Medical Information Systems, Inc., 1988.

Sears, W. and Sears, M. **Breastfeeding Your Baby.** McHenry, IL: Medela, Inc., 1988.

Sears, W. **Keys to Breastfeeding.** Hauppauge, NY: Barron's Educational Series, Inc., 1991.

Woessner, C., et al. **Breastfeeding Today: A Mother's Companion.** Garden City Park, NY: Avery Publishing Group, Inc., 1991.

Worthington-Roberts, B. and Williams, S.R. **Nutrition in Pregnancy and Lactation.** St. Louis, MO: Times Mirror/Mosby College Publishing, 1989.

Selected Ethnic and Cultural Influences on Infant Nutrition and Feeding

U.S. Department of Agriculture and U.S. Department of Health and Human Services. **Cross-Cultural Counseling: A Guide for Nutrition and Health Counselors.** Washington, DC: U.S. Department of Agriculture, 1986.

Bertelsen, C. and Auerbach, K.G. Nutrition and breastfeeding: The cultural connection. **Lactation Consultant Series (Unit 11). La Leche League International, Inc.,** 1987.

Betts, N.M. and Weidenbenner, A. Dietary intakes, iron status, and growth status of Southeast Asian refugee children. **Nutrition Research** 6: 509-515, 1986.

Biegelson, D., Cowell, C., and Goldberg, D. Breast-feeding practices in a low-income population in New York City: A study of selected health department child health stations. **J. Am. Diet Assoc.** 86:90, 1986.

Bowering, J. Infant nutrition in East Harlem. **Human Ecol. Forum** 6:17-19, 1976.

Breastfeeding and weaning in Mexico and the US. **Nut. Rev.** 44:104- 106, 1986.

Brodwick, M., Baranowski, T., and Rassin, D.K. Patterns of infant feeding in a tri-ethnic population. **J. Am. Diet. Assoc.** 89:1129- 1132, 1989.

Brown, L.K. and Mussell, K. **Ethnic and Regional Foodways in the United States.** Knoxville, TN: The University of Tennessee Press, 1984.

Brownlee, A.T. **Community, Culture and Care: A Cross-Cultural Guide for Health Workers.** St. Louis, MO: C.V. Mosby Co., 1978.

Bryant, C.A., et al. **The Cultural Feast—An Introduction to Food and Society.** St. Paul, MN: West Publishing Company, 1985.

Center for Applied Linguistics. **The Peoples and Cultures of Cambodia, Laos, and Vietnam.** Washington, DC: Language and Orientation Resource Center, 1981.

Clark, A.L. **Culture and Childrearing.** Philadelphia, PA: F.A. Davis Co., 1981.

Gabriel, A., Gabriel, K.R., and Lawrence, R.A. Cultural values and biomedical knowledge: Choices in infant feeding. **Soc. Sci. Med.** 23:501, 1986.

Kittler, P.G. and Sucher, K. **Food and Culture in America.** New York, NY: Van Nostrand Reinhold, 1989.

Kokinos, M. and Dewey, K.G. Infant feeding practices of migrant Mexican-American families in northern California. **Ecol. Food Nutr.** 18: 209-220, 1986.

Mackenzie, M. The anthropology of others and of ourselves related to the weanling. **AJCN** 41 (Suppl. 2): 497-501, 1985.

Newman, J.M. **Melting Pot: An Annotated Bibliography and Guide to Food and Nutrition Information for Ethnic Groups in America.** New York, NY: Garland Pub., 1986.

Parraga, I.M., Weber, M.A., Engel, A., Reeb., K.G., and Lerner, E. Feeding patterns of urban black infants. **J. Am. Diet. Assoc.** 88:796, 1988.

Raphael, D. Weaning is always: the anthropology of breastfeeding behavior. **Ecol. Food Nutr.** 15:203-213, 1984.

Raphael, D. and Davis, F. **Only Mothers Know: Patterns of Infant Feeding in Traditional Cultures.** Westport, CT: Greenwood Press, 1985.

Robson, J.R.K. **Food, Ecology, and Culture: Readings in the Anthropology of Dietary Practice.** New York, NY: Gordon and Breach, 1980.

Samuels, S.E. Social and cultural determinants of breastfeeding in the United States. **Nutr. Update** 2:195-205, 1985.

Sanjur, D. **Social and Cultural Perspectives in Nutrition.** Englewood Cliffs, NJ: Prentice-Hall, Inc., 1982.

Schaefer, L.J. and Kumanyika, S.K. Maternal variables related to potentially high-sodium infant feeding practices. **J. Am. Diet. Assoc.** 85:433-438, 1985.

Springer, L. and Thomas, J. Rastafarians in Britain: a preliminary study of food habits and beliefs. **Human Nutrition: Applied Nutrition** 37A: 120-127, 1983.

Sue, D. (ed.) **Counselling the Culturally Different.** New York, NY: Wiley, 1981.

Taylor, M.M. Transcultural aspects of breast-feeding—U.S.A. **Lactation Consultant Series (Unit 2). La Leche League International, Inc.,** 1985.

Selected References on Parenting of Infants and Infant Development

Alexander, T.P. **Making Room For Twins: A Complete Guide to Pregnancy, Delivery, and the Childhood Years.** New York, NY: Bantam Books, 1987.

Baldwin, R. **You Are Your Child's First Teacher.** Berkeley, CA: Celestial Arts, 1989.

Bengtson, V.L. and Robertson, J., eds. **Grandparenthood.** Troy, NY: Sage Publishing, 1985.

Bowman, N.H., et al. **Grandparenting Book.** Saratoga, CA: R & E Publishers, 1982.

Brazelton, T.B. **Infants and Mothers: Differences in Development.** New York, NY: Dell Publishing Co., Inc., 1983.

Brazelton, T.B. **On Becoming a Family: The Growth of Attachment.** New York, NY: Dell Publishing Co., Inc., 1981.

Brazelton, T.B. **What Every Baby Knows.** New York, NY: Ballantine Books, 1987.

Brazelton, T.B. **Work and Caring.** Reading, MA: Addison-Wesley Publishing Company, Inc., 1987.

Brazelton, T.B. and Cramer, B.G. **The Earliest Relationship: Parents, Infants and the Drama of Early Attachment.** Reading, MA: Addison-Wesley Publishing Company, Inc., 1990.

Burck, F.W. **Babysense.** New York, NY: St. Martins Press, 1991.

Caplan, F. **The First 12 Months of Life: Your Baby's Growth Month by Month.** New York, NY: Bantam Books, 1973.

Carter, L. and Ostrow, L.S. **The Miracle Year: An Expectant Parents' Guide to the Miraculous 6 Months Before—And After—the Birth of their First Baby.** New York, NY: Pocket Books, 1991.

Chubet, C.T. **Raising a Happy Baby: From Infant to Toddler.** Stamford, CT: Longmeadow Press, 1988.

Clarke, J.I. and Dawson, C. **Growing Up Again: How to Parent Yourself So You Can Parent Your Children.** San Francisco, CA: Harper, 1989.

Clegg, A. and Woolett, A. **Twins: From Conception for Five Years.** New York, NY: Ballantine Books, 1988.

Cole, J. and Clamenson, S. **Safe from the Start: Your Child's Safety from Birth to Age Five.** New York, NY: St. Martins Paperbacks, 1989.

Dodson, F. **How to Father.** New York, NY: Penguin Books USA Inc., 1974.

Dodson, F. **How to Parent.** New York, NY: Penguin Books USA Inc., 1970.

Eisenberg, A., Murkoff, H.E., and Hathaway, S.E. **What to Expect the First Year.** New York, NY: Workman Publishing, 1989.

Fisher, J.J., ed. **Johnson and Johnson's From Baby to Toddler.** New York, NY: The Putnam Publishing Group, 1988.

Fraiburg, S.H. **The Magic Years: Understanding and Handling the Problems of Early Childhood.** New York, NY: Charles Scribner's Sons, 1959.

Franck, I. and Brownstone, D. **The Parents Desk Reference.** New York, NY: Prentice Hall, 1991.

Friedrich, E. and Rowland, C. **The Parent's Guide to Raising Twins.** New York, NY: St. Martin's Press, 1984.

Galinsky, E. **The Six Stages of Parenthood.** Reading, MA: Addison- Wesley Publishing Company, Inc., 1987.

Gillis, J. and Fise, M.E.R. **The Childwise Catalog: A Consumer Guide to Buying the Safest and Best Products for Your Children.** New York, NY: Harper and Row Publishers, 1990.

Greenspan, S. and Greenspan, N.T. **First Feelings: Milestones in the Emotional Development of Your Baby and Child.** New York, NY: Viking Penguin, 1989.

Guhl, B. and Fontenelle, D. **Purrfect Parenting.** Tucson, AZ: Fisher Books, 1987.

Harrison, H. and Kositsky, A. **The Premature Baby Book: A Parent's Guide to Coping and Caring in the First Years.** New York, NY: St. Martin's Press, 1983.

Hopson, D.P. and Hopson, D.S. **Different and Wonderful: Raising Black Children in a Race-Conscious Society.** New York, NY: Simon & Schuster, 1990.

Jason, J., and Van Der Meer, A. **Parenting Your Premature Baby: A Complete Guide to Birth, Postpartum Care, and Early Childhood.** New York, NY: Dell Publishing Co., Inc., 1989.

Jessel, C. **From Birth to Three: An Illustrated Journey through Your Child's Early Physical and Emotional Development.** New York, NY: Dell Publishing Co., Inc., 1990.

Kelly, P., ed. **First-Year Baby Care: An Illustrated Step-by-Step Guide for New Parents.** Deephaven, MN: Meadowbrook, Inc., 1989.

Kelly, M. and Parsons, E. **The Mother's Almanac.** New York, NY: Doubleday, 1992.

Kiester, E., Jr., Kiester, S.V. and the Editors of Better Homes and Gardens Books. **Better Homes and Gardens New Baby Book.** New York, NY: Bantam Books, 1985.

Kitzinger, S. **The Crying Baby.** New York, NY: Viking Penguin, 1990.

Lamb, M.E., and Bornstein, M.H. **Development in Infancy: An Introduction.** New York, NY: Random House, 1987.

Lansdown, R. and Walker, M. **Your Child's Development from Birth through Adolescence.** New York, NY: Alfred A. Knopf, 1991.

Lansky, V. **Practical Parenting Tips.** Deephaven, MN: Meadowbrook, 1982.

Lansky, V. **The Best of Vicki Lansky's Practical Parenting Tips.** New York, NY: Book Peddlers, 1987.

Leach, P. **Babyhood.** New York, NY: Alfred A. Knopf, 1990.

Leach, P. **The First Six Months: Getting Together with Your Baby.** New York, NY: Alfred A. Knopf, 1987.

Leach, P. **Your Baby and Child from Birth to Age Five.** New York, NY: Alfred A. Knopf, 1990.

Lewis, C.C. **Mother's First Year.** New York, NY: Berkley Books, 1989.

Lief, N.R. and Fahs, M.E. **The First Year of Life.** New York, NY: Walker Publishing Company, Inc., 1991.

Manginello, F.P. and DiGeronimo, T.F. **Your Premature Baby: Everything You Need to Know about the Childbirth, Treatment, and Parenting of Premature Infants.** New York, NY: John Wiley & Sons, Inc., 1991.

McBride, K. **Tips for Working Parents: Creative Solutions to Everyday Problems.** Pownal, VT: Storey Communications, Inc., 1989.

Morris, D. **Baby Watching.** New York, NY: Crown Publishers, Inc., 1992.

Neifert, M.E., Price, A., and Dana, N. **Dr. Mom: A Guide to Baby and Child Care.** New York, NY: Penguin Books USA, Inc., 1986.

Noble, E. and Sorger, L. **Having Twins: A Parent's Guide to Pregnancy, Birth and Early Childhood.** Boston, MA: Houghton Mifflin Company, 1991.

Novotny, P.P. **The Joy of Twins: Having, Raising, and Loving Babies Who Arrive in Groups.** New York, NY: Crown Publishers, Inc., 1988.

Olds, S.W. **The Working Parents' Survival Guide.** Allston, MA: Prima Publishing, 1989.

Pedersen, A., and O'Mara, P., eds. **Being a Father—Family, Work and Self.** Sante Fe, NM: John Muir Publications, 1990.

Presser, J. **Inspiring Parenthood.** New York, NY: Ballantine Books, 1990.

Rakowitz, E. and Rubin, G.S. **Living with Your New Baby: A Postpartum Guide for Mothers and Fathers.** New York, NY: Berkley Books, 1985.

Rosemond, J.K. **Parent Power! A Commonsense Approach to Parenting in the 90's and Beyond.** Kansas City, MO: Andrews and McMeel, 1990.

Sears, W. **Becoming a Father: How to Nurture and Enjoy Your Family.** Franklin Park, IL: La Leche League International, 1986.

Sears, W. **The Fussy Baby: How to Bring Out the Best in Your High-Need Child.** New York, NY: NAL/Dutton, 1987.

Sears, W. **Growing Together: A Parent's Guide to Baby's First Year.** Franklin Park, IL: La Leche League International, 1987.

Sears, W. **Keys to Becoming a Father.** Hauppauge, NY: Barron's Educational Series, Inc., 1991.

Sears, W. **Keys to Caring and Preparing for Your Newborn.** Hauppauge, NY: Barron's Educational Series, Inc., 1991.

Sears, W. **Keys to Comforting the Fussy Baby.** Hauppauge, NY: Barron's Educational Series, Inc., 1991.

Sears, W. **Nightime Parenting.** New York, NY: NAL/Dutton, 1987.

Sears, W. **Your Baby: The First Twelve Months.** Hauppauge, NY: Barron's Educational Series, Inc., 1989.

Spock, B. **Dr. Spock on Parenting.** New York, NY: Pocket Books, 1988.

Spock, B., and Rothenberg, M.B. **Dr. Spock's Baby and Child Care.** New York, NY: Pocket Books, 1992.

Stern, D.N. **Diary of a Baby: What Your Child Sees, Feels and Experiences.** New York, NY: Basic Books, 1990.

Stewart, D. **Fathering and Career: A Healthy Balance.** Marble Hill, MO: NAPSAC Reproductions, 1987.

Sullivan, S.A. **The Father's Almanac.** New York, NY: Doubleday, 1980.

Vanderwort, D., and the Editors of Sunset Books and Sunset Magazine. **Making Your Home Child-Safe.** Menlo Park, CA: Lane Publishing Co., 1988.

Weiss, J.S. **Your Second Child.** New York, NY: Summit Books, 1981.

White, B.L. **The First Three Years of Life.** New York, NY: Prentice Hall Press, 1990.

White, L.B. **The Grandparent Book: Thoroughly Modern Grandparenting.** San Rafael, CA: Gateway Books, 1990.

Worth, C. **The Birth of a Father: New Fathers Talk About Pregnancy, Childbirth, and the First Three Months.** New York, NY: McGraw-Hill Publishing Co., 1988.

Selected Audiovisuals on Infant Feeding

Audiovisuals on breastfeeding are listed in:

- U.S. Department of Agriculture: **WIC Breastfeeding Promotion Study and Demonstration, Phase IV Report, Volumes I and II.** Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service, 1990.

- U.S. Department of Agriculture: **Nutrition Education Resource Guide: An Annotated Bibliography of Educational Materials for the WIC and CSF Programs—1991,** No. 94, Washington, DC: U.S. Department of Agriculture, 1991.

Feeding with Love and Good Sense: An Instructional Videotape on Feeding. Ellen Satter, Palo Alto, CA: Bull Publishing Company, 1989. A series of four videotapes on nutrition and the feeding relationship with a separate videotape for:

- The infant;
- The older baby;
- The toddler;
- The preschooler.

The videotapes can be used for inservice training sessions or in working with caregivers of infants and children. Concerning availability, contact your State WIC Program office; the Food and Nutrition Information Center (below); or Bull Publishing Company, P.O. Box 208, Palo Alto, CA 94302-0208, Telephone (415) 322-2855.

Time to Eat! Nutrition for Young Children. West Lafayette, IN: The Center for Instructional Services, Indiana Cooperative Services, 1984. A 29-minute VHS videotape which includes sections on infant nutrition and child nutrition. Concerning availability, contact the Food and Nutrition Information Center (below); or the Agricultural Communication Service, Media Distribution Center, 301 South 2nd St., Lafayette, IN 47905-1092.

Nutrition for the Newborn. Malibu, CA: The Polished Apple, 1983. Available in a 43-minute VHS videotape, slide-tape, or filmstrip, this audiovisual covers all aspects of infant feeding including breastfeeding, formula feeding, and supplemental foods. Concerning availability, contact the Food and Nutrition Information Center (below); or The Polished Apple, P.O. Box 962, Pacific Palisades, CA 90272-9907, Telephone (213) 459-2630.

Infant Care: The First Weeks. Los Angeles, CA: Churchill Films, 1987. Available in a 21-minute VHS videotape, this audiovisual covers the overall care of infants (including an infant's basic needs of food, water, warmth, comfort, and cleanliness; infant crying as a means of communication; and techniques of breastfeeding, bottle feeding, bathing, diaper changing, calming a fussy infant, and holding an infant). Concerning availability, contact the Food and Nutrition Information Center (below).

Additional Resource Materials on Infant Nutrition Topics

Additional resources on infant nutrition can be obtained from:

- The Food and Nutrition Information Center (FNIC)
  National Agricultural Library
  10301 Baltimore Boulevard, Room 304
  Beltsville, MD 20705
  Phone: (301) 504-5719

The FNIC serves persons seeking information or educational materials in the area of food and human nutrition. The Center acquires books, journal articles, and audiovisual materials pertaining to human nutrition, food service management, and food science. The FNIC lends books and

audiovisual materials, provides photocopies of journal articles, and provides comprehensive reference services (including computer searches of major databases, "factfinding," and referrals) to staff of the WIC and CSF Programs.

- The National Center for Education in Maternal and Child Health (NCEMCH) and the National Maternal and Child Health Clearinghouse (NMCHC)
  Georgetown University
  2000 15th Street, North, Suite 701
  Arlington, VA 22201-2617
  Phone (703) 524-7802

The NCEMCH and the NMCHC are sister organizations that provide maternal and child health-related information services and technical assistance to organizations, agencies, and consumers. The NCEMCH responds to information requests, maintains a reference collection of MCH program materials, develops publications on maternal and child health topics, and provides technical assistance in educational resource development, program planning, and topical research. The NMCHC provides current information through the collection and dissemination of publications (e.g., resource directories, topical bibliographies, information packets, proceedings, and reports). Most publications distributed by the Clearinghouse are available in limited quantities at no cost.

Index

Acknowledgments

This handbook was prepared by Donna M. Blum, M.S., R.D., Nutrition and Technical Services Division.

Some sections of this publication were adapted from the guidebook "Feeding Infants: A Guide for Use in the Child Care Food Program," FNS- 258, prepared by Anne Jacobs Molofsky, M.S., R.D., Nutrition and Technical Services Division.

We especially appreciate the generous assistance of Ellyn Satter in reviewing the publication and for granting permission to use material from her books, **Child of Mine: Feeding with Love and Good Sense** and **How to Get Your Kid to Eat...But Not Too Much.**

We would like to acknowledge and express our deep appreciation to the following individuals who reviewed this publication and provided valuable comments:

Outside Reviewers:

- Kathryn Camp, M.S., R.D., L.D., Director of Nutrition for Clinical Services, Department of Pediatrics, Georgetown University Medical Center, Washington, DC
- Clinical Affairs Committee, American Academy of Pediatric Dentistry, Chicago, IL
- M.T. DiFerrante, M.P.H., R.D., L.D., Chief, Nutrition Services, City of Houston, Department of Health and Human Services, Houston, TX
- Vergie I. Hughes, R.N., B.S.N., I.B.C.L.C., Nursing Coordinator, National Capital Lactation Center, Georgetown University Hospital, Washington, DC
- William J. Klish, M.D., Professor of Pediatrics, Head, Pediatric Gastroenterology, Baylor College of Medicine, Houston, TX
- Betty Whittle Kozlowski, Ph.D., Associate Professor, Department of Human Nutrition and Food Management and Chief of Nutrition, Nisonger Center University Affiliated Program for Mental Retardation and Developmental Disabilities, Ohio State University, Columbus, OH
- Vicki Newman, M.S., R.D., Perinatal Nutritionist, Wellstart, San Diego, CA
- Donna O'Hare, M.D., FAAP, Project Director, MIC-FPP/MHRA, Clinical Professor of Pediatrics, New York University School of Medicine, New York, NY
- Ellyn Satter, R.D., M.S., M.S.S.W., Author, Therapist, Consultant, Madison, WI
- Carolyn Sharbaugh, R.D., M.S., Nutrition Consultant, National Center for Education in Maternal and Child Health, Rosslyn, VA
- John N. Udall, M.D., Professor of Pediatrics, Department of Pediatrics, Louisiana State University Medical Center, New Orleans, LA

Reviewers from Federal Agencies:

- Corinne Montandon, Dr.P.H., R.D., L.D., Assistant Professor of Nutrition and Administrative Nutritionist
  Janice E. Stuff, M.S., R.D., L.D., Research Instructor
  Judy Hopkinson, Ph.D., Research Assistant Professor
  Children's Nutrition Research Center, Baylor College of Medicine, Agricultural Research Service, U.S. Department of Agriculture, Houston, TX
- Mariel Caldwell, M.S., M.P.H., R.D., Regional Nutrition Consultant, Maternal and Child Health/Family Planning Services, U.S. Public Health Service, Department of Health and Human Services, Chicago, IL
- Susan Conley, Home Economist, Manager, Meat and Poultry Hotline, Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC

- Dolores M. Malvitz, Dr.P.H., Acting Branch Chief
  Kim L. Cowles, D.D.S., Dental Officer
  Allen M. Bergeson, D.M.D., M.P.H., Dental Officer
  Linda S. Crossett, R.D.H., B.S., Dental Health Program Specialist
  Barbara Z. Park, R.D.H., M.P.H., Dental Health Specialist
  Division of Oral Health, National Center for Prevention Services, Centers for Disease Control and Prevention, Atlanta, GA
- Sandy Facinoli, M.S., Coordinator
  Natalie Updegrove, M.S., R.D., Nutritionist
  Food and Nutrition Information Center, National Agricultural Library, U.S. Department of Agriculture, Beltsville, MD
- Myrtle Hogbin, R.D., Home Economist
  Lois H. Fulton, M.S., R.D., Supervisory Home Economist
  Nutrition Education Division, Human Nutrition Information Service, U.S. Department of Agriculture, Beltsville, MD
- M. Yvonne Jackson, Ph.D., R.D., Chief, Nutrition and Dietetics Section, Indian Health Service, Department of Health and Human Services, Washington, DC
- Denise Sofka, M.P.H., Nutrition Specialist, Infant and Childhood Health Branch, Maternal and Child Health Bureau, Health Resources and Services Administration, Department of Health and Human Services, Washington, DC
- Wells Willis, M.S., R.D., National Program Leader, EFNEP, Extension Service, U.S. Department of Agriculture, Washington, DC
- Staff from the Food and Nutrition Service, USDA: Nancy Bates, Francesca Bravo, Patricia Daniels, Barbara Hallman, Rhonda Kane, Michele Lawler, Helen Lilly, Brenda Lisi, Susan Mayer, Elaine McLaughlin, Vee Ann Miller, Stella Nash, John Patrick Passino, Delores Stewart, and Ronald Vogel.
- Members of the Dietary Guidance Working Group

Reviewers from WIC State and Local Agencies:

- Charlotte W. Bedell, M.S., R.D., L.D., District Chief of Nutrition, WIC Program, Albany, GA
- Regine Beakes, M.S.P.H.N., WIC Nutrition Consultant, Connecticut WIC State Agency, Hartford, CT
- Becky K. Bessette, M.S., R.D., Nutrition Coordinator, Rhode Island WIC State Agency, Providence, RI
- Dawn M. Cooley, M.S., R.D., L.D., Nutrition Supervisor, Health Planning Unit, Ohio Department of Health, Bureau of WIC, Columbus, OH
- Kay Dutram, M.S., L.R.D., WIC Nutrition Coordinator, Maine WIC State Agency, Augusta, ME
- Laurie Eynon, R.D., Nutritionist, Indiana WIC State Agency, Indianapolis, IN
- Lisa Ferriero, M.S., R.D., Nutrition Coordinator, New Hampshire WIC State Agency, Concord, NH
- Chris Fogelman, R.D., M.P.H., Public Health Nutritionist, Montana WIC State Agency, Helena, MT
- Judythe Gatchell, M.S., R.D., L.D., WIC Nutrition Coordinator, Maine WIC State Agency, Augusta, ME
- Elaine Goodson, M.S., R.D., L.D., Nutrition Education Coordinator, Bureau of WIC Nutrition, Texas WIC State Agency, Austin, TX
- Stacey Gyenizse, R.D., Nutrition Education/Breastfeeding Coordinator, Intertribal Council of Arizona, Phoenix, AZ
- Susanne Gregory, B.S., State Nutrition Specialist, Massachusetts WIC State Agency, Boston, MA
- Pat Hennessey, M.S., R.D., Nutrition Coordinator, Montana WIC State Agency, Helena, MT

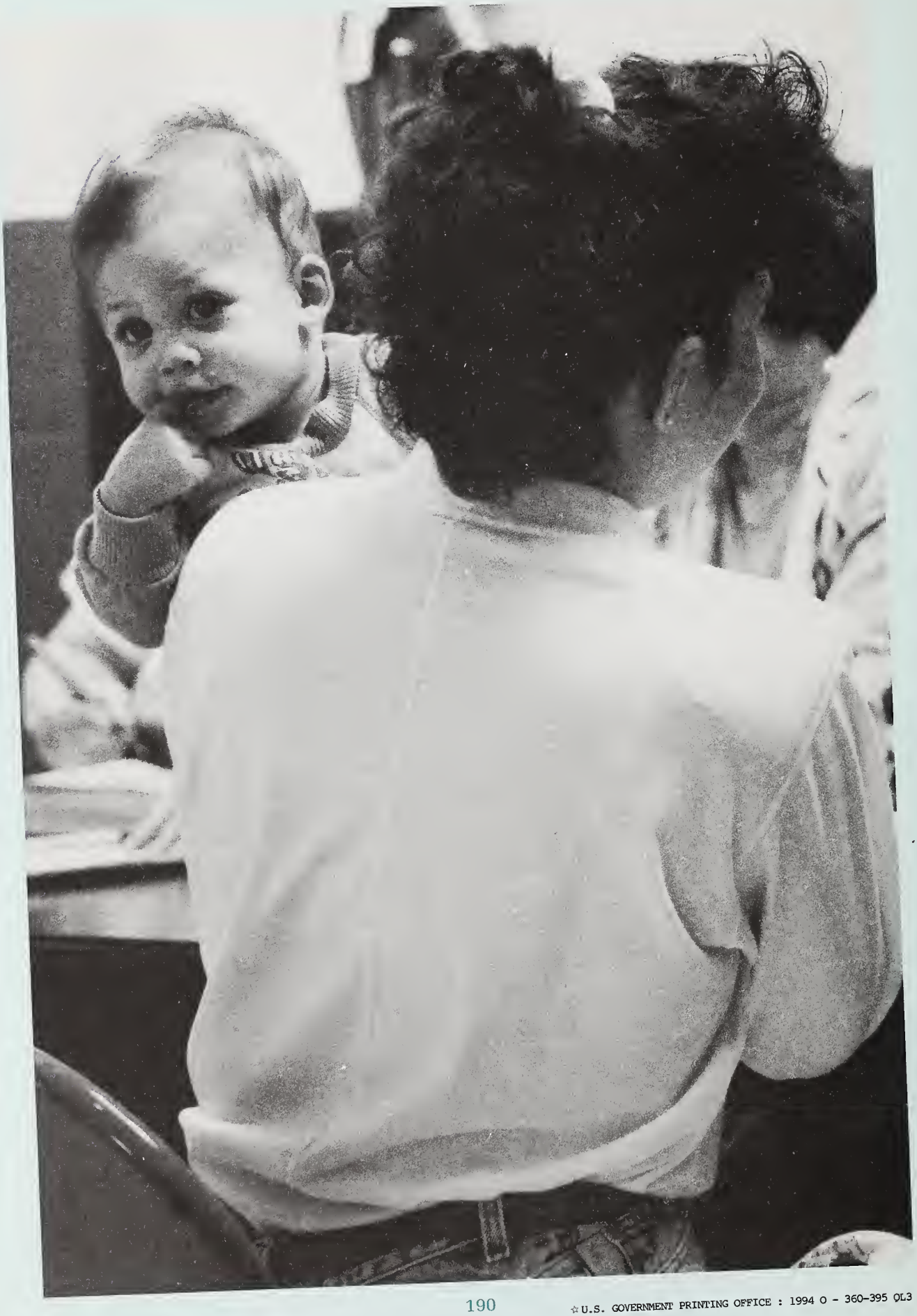
- Marilyn Hughes, M.S., R.D., L.D., Nutrition Coordinator, Georgia WIC State Agency, Atlanta, GA
- Carolyn T. Ingle, R.D., Nutrition and Clinic Services Consultant, Indiana WIC State Agency, Indianapolis, IN
- Susan Jackman, M.S., R.D., Nutrition Coordinator, Connecticut WIC State Agency, Hartford, CT
- Pat Jackson, B.Sc., L.D., Nutrition Program Consultant, Savannah- Chatham WIC Program, Savannah, GA
- Alice Jones, R.D., L.D., WIC Nutrition Education Coordinator, Pueblo of Zuni WIC Program, Zuni, NM
- Jan Kallio, M.S., R.D., Nutrition Coordinator, Massachusetts WIC State Agency, Boston, MA
- Betty Kenyon, C.N., R.D., Nutrition Services Director, Panhandle Community Services, Gering, NE
- Marilyn Lynch, M.S., R.D., Coordinator of Nutrition Services, New Jersey WIC State Agency, Trenton, NJ
- Cynthia Maki, M.S., R.D., WIC Nutrition Education Coordinator, Division of Special Food Programs (WIC), Pennsylvania Department of Health, Harrisburg, PA
- Barbara A. Martin, R.D., L.D., Nutritionist Supervisor, Ohio WIC State Agency, Columbus, OH
- Kathleen McElligott, M.S., R.D., Nutrition Coordinator, Rhode Island WIC State Agency, Providence, RI
- Joan McGill, M.S., R.D., Chief Nutritionist, Nutrition Services, Colorado Department of Health, Denver, CO
- Laura McKelvey, B.S., Nutritionist, Cobb County WIC Program, Marietta, GA
- Carol Meredith, Ph.D., Public Health Nutrition Consultant, California WIC State Agency, Sacramento, CA
- Susan Miller, R.D., L.D., Senior Nutritionist, WIC Program, Albany, GA
- Jacquelynn Nelson, M.S.A., R.D., L.D., Nutrition Program Consultant, WIC Program, Macon, GA
- Robyn Osborn, M.Ed., R.D., Director, Nutrition and Clinic Services, Indiana WIC State Agency, Indianapolis, IN
- S. Diann Pace, L.D., Nutritionist, Southside Healthcare, Inc. WIC Program, Atlanta, GA
- Lielle Pacco, R.D., Nutritionist, Yale/New Haven Hospital WIC Program, New Haven, CT
- Marsha Pearlman, I.B.C.L.C., Lactation Consultant, Florida WIC State Agency, Tallahassee, FL
- Lorelle Porrazzo, M.S., R.D., WIC Program Nutritionist, Yale-New Haven Hospital, New Haven, CT
- Kathy Reeves, M.S., R.D., Public Health Nutrition Consultant, Florida WIC State Agency, Tallahassee, FL
- Penelope Rieley, M.S., R.D., WIC Nutrition Coordinator, Vermont WIC State Agency, Burlington, VT
- Marianne Romano, R.D., Public Health Nutritionist, New York WIC State Agency, Albany, NY
- Janet Rourke, WIC Breastfeeding Promotion Coordinator, Bureau of WIC Nutrition, Texas WIC State Agency, Austin, TX
- Sandra Sangster, Nutrition Consultant, Intertribal Council of Arizona, Phoenix, AZ
- Donna Morse, M.S., R.D., L.D., Nutrition Services Supervisor, El Paso WIC Program, El Paso, TX
- Debra C. Stabeno, Chief, Bureau of WIC Nutrition, Texas WIC State Agency, Austin, TX

- Ann Twiggs, R.D., L.D., Nutritionist, Ohio WIC State Agency, Columbus, OH
- Helen Burns Twomey, R.D., Nutrition Coordinator, Jay Wells County WIC Program, Portland, IN
- Merryjo H. Ware, M.P.H., R.D., Executive, Nutrition Services Coordinator, Illinois Department of Health, Chicago, IL
- Connie Welch, M.P.H., R.D., WIC Nutrition Coordinator, Wisconsin WIC State Agency, Madison, WI
- Suzanne P. Wilson, M.S., R.D., Public Health Nutrition Program Manager, Florida WIC State Agency, Tallahassee, FL

Photograph Credits:

- Photograph of mother wearing nursing bra with baby on page 62 courtesy of Leading Lady Companies, Beachwood, OH.
- Photograph of nursing pads on page 63 courtesy of Ameda Egnell, Cary, IL.
- Photograph of breast shells on page 63 from the publication: Riordan, Jan and Auerbach, Kathleen. **Breastfeeding and Human Lactation**. ©1993 Boston, MA: Jones and Bartlett Publishers. Reprinted with permission. Photograph courtesy of St. Joseph's Medical Center, Wichita, Kansas.
- Photograph of woman using nursing supplementer on page 64 courtesy of J.L. Avery, Lact-Aid International, Inc., Athens, TN.
- Photograph of nursing supplementer displayed alone on page 64 courtesy of Medela, Inc., McHenry, IL.
- Photograph of nipple shield on page 65 courtesy of Medela, Inc., McHenry, IL.
- Photographs of healthy teeth and tooth decay courtesy of David Johnsen, D.D.S., Professor of Pediatric Dentistry, Case Western Reserve University, Cleveland Ohio.

The resources and references listed in this handbook do not imply endorsement by the Food and Nutrition Service, U.S. Department of Agriculture.



☆U.S. GOVERNMENT PRINTING OFFICE : 1994 O - 360-395 QL3

Reader Response

Infant Nutrition and Feeding:
A Reference Handbook for Nutrition and Health Counselors in the WIC and CSF Programs

Dear Reader,

Please take a few minutes to complete this form, tear it out, fold, seal it with tape, and mail it. Although not mandatory, your response will help us evaluate the usefulness of this guide. Thank you!

Please comment on the content of this handbook:

Chapter/Section	Information Is Useful/Clear	Information is Not Useful/Clear	Other Comments
Nutritional Needs of Infants			
Development of An Infant's Feeding Skills			
Breastfeeding			
Formula Feeding			
Infant Foods			
Special Concerns in Infant Feeding			
Summary of Key Points			
Appendix			
Figures and Tables			
Selected Bibliography			

Are you planning to use the handbook? ___Yes ___No

If Yes, how will you use it?

— As a reference guide
— As a resource in planning topics to cover at individual counseling sessions and group classes
— As a resource in planning inservice training sessions for other professionals or paraprofessionals
— Other (please describe) _____

If this publication was revised, what changes would you suggest? Please include any other comments on this handbook.

Title _____

Organization/Program _____

City and State _____

U.S. DEPARTMENT OF AGRICULTURE
FOOD AND NUTRITION SERVICE
ALEXANDRIA VA 22302-1594

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS PERMIT NO. 12725 WASHINGTON, D.C.

POSTAGE WILL BE PAID BY FOOD AND NUTRITION SERVICE

NUTRITION AND TECHNICAL SERVICES DIVISION
U.S. DEPARTMENT OF AGRICULTURE
FOOD AND NUTRITION SERVICE
3101 PARK CENTER DRIVE RM 609
ALEXANDRIA VA 22302-9903

FOLD HERE

PLEASE DO NOT STAPLE

PUT TAPE HERE